REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
FINAL WORK PLAN
EXTERIOR INDUSTRIAL WASTE DITCH
OPERABLE UNIT 8-07
NAVAL REACTORS FACILITY
IDAHO FALLS, IDAHO

Idaho
National
Engineering
Laboratory

Prepared for the
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IDAHO FALLS, IDAHO

September 1992

Prepared for the
U.S. Department of Energy
Pittsburgh Naval Reactors Office
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PREFACE

The Idaho National Engineering Laboratory (INEL), located in southeastern Idaho, is a government-owned reservation managed by the U.S. Department of Energy (DOE); it was listed on the National Priorities List (NPL) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) in November 1989.

In accordance with the requirements of CERCLA, the Environmental Protection Agency (EPA), and the State of Idaho, Department of Health and Welfare (IDHW) negotiated a Federal Facilities Agreement/Consent Order and Action Plan [hereinafter referred to as the FFA/CO]. This agreement describes the methods by which DOE, EPA, and IDHW will implement CERCLA and Resource Conservation and Recovery Act (RCRA) corrective action activities at INEL release sites.

The exterior Industrial Waste Ditch (IWD) at the Naval Reactors Facility (NRF) Waste Area Group (WAG) 8 at the INEL has been identified as an operable unit pursuant to the FFA/CO. NRF and the IWD did not qualify for listing on the NPL as individual sites, but were included with other INEL sites in the FFA/CO. The general purposes of this agreement are to:

1) Assure that past and present activities at NRF are thoroughly investigated and that appropriate removal and remedial action(s), if any, are taken as necessary to protect the public health, welfare, and the environment.

2) Establish a procedural framework and schedule for developing, implementing, and monitoring appropriate response actions at NRF in accordance with CERCLA and the National Contingency Plan (NCP).

This investigation encompasses only the IWD channel outside the NRF security fence. The interior portion of the effluent discharge system will be addressed under the FFA/CO provisions for Track 2 investigations. Hereafter, unless otherwise specified, IWD shall mean only that portion of the entire system which lies outside the NRF security fence.

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ACRONYMS

A1W	Large Ship Reactor Prototype
ARARs	Applicable or Relevant and Appropriate Requirements
ASTM	American Society for Testing and Materials
bls	below land surface
CAA	Clean Air Act
CDI	Chronic Daily Intake
CEC	Cation Exchange Capacity
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CIR	Cancer Incidence Rate
CLP	Contract Laboratory Program
COCA	Consent Order and Compliance Agreement
CRP	Community Relations Plan
CSM	Conceptual Site Model
CWA	Clean Water Act
DMP	Data Management Plan
DOE	Department of Energy
DOE-ID	Department of Energy, Idaho Field Office
DQO	Data Quality Objective
DWTM	Office of Defense Waste and Transportation Management
ECAO	Environmental Criteria and Assessment Office
ECF	Expended Core Facility
E_h	Oxidation and Reduction Coefficient
EPA	Environmental Protection Agency
ESRP	Eastern Snake River Plain
FFA/CO	Federal Facilities Agreement/Consent Order
FR	Federal Register
FS	Feasibility Study
FSP	Field Sampling Plan
HASP	Health and Safety Plan
HHEM	Human Health Evaluation Manual
HRS	Hazard Ranking System
IBO	DOE Naval Reactors Idaho Branch Office
IWD	Exterior Industrial Waste Ditch
HWRAD	Hazardous Waste Remedial Action Division
INEL	Idaho National Engineering Laboratory
IDHW	State of Idaho Department of Health and Welfare
MDL	Method Detection Limit
MOSA	Methods of Soil Analysis
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NIOSH	National Institute of Occupational Safety and Health
NPL	National Priorities List
NRF	Naval Reactors Facility
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability

ACRONYMS

PMP	Project Management Plan
PP	Proposed Plan
ppb	parts per billion
PPE	Personal Protective Equipment
ppm	parts per million
PRAO	Preliminary Remedial Action Objectives
PREPP	Process Experimental Pilot Plant
QA/QC	Quality Assurance/Quality Control
QAPjP	Quality Assurance Project Plan
QAPP	Quality Assurance Program Plan
RCRA	Resource Conservation and Recovery Act
RFD	Reference Dose
RFI	RCRA Facility Investigation
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure
ROD	Record of Decision
S1W	Submarine Thermal Reactor Prototype
S5G	Advanced Water Cooled Submarine Thermal Reactor Prototype
SARA	Superfund Amendments and Reauthorization Act
SDI	Subchronic Daily Intake
SOP	Standard Operating Procedure
SOW	Statement of Work
SRPA	Snake River Plain Aquifer
SW	Solid Waste
SVOCs	Semi-Volatile Organic Compounds
TCL	Target Compound List
TIC	Tentatively Identified Compound
TCLP	Toxicity Characteristic Leaching Procedure
TOX	Total Organic Halides
TRA	Test Reactor Area
TPH	Total Petroleum Hydrocarbons
USCG	United States Coast Guard
USGS	United States Geological Survey
VOCs	Volatile Organic Compounds
WAG	Waste Area Group

EXECUTIVE SUMMARY

The Idaho National Engineering Laboratory (INEL) has been divided into ten Waste Area Groups (WAGs) to facilitate the remediation process. Each WAG is further divided into Operable Units (OUs) which focus on specific areas of interest. The Naval Reactors Facility (NRF) Exterior Industrial Waste Ditch (IWD) Remedial Investigation and Feasibility Study (RI/FS) is OU 8-07 under the Federal Facility Agreement and Consent Order (FFA/CO). The Environmental Protection Agency (EPA) has been identified as the lead agency and the State of Idaho Department of Health and Welfare (IDHW) as the support agency for OU 8-07.

The NRF IWD has been identified for a RI/FS due to the historic nonradioactive discharges of industrial waste water such as cooling systems water, ion exchange regeneration solutions, and liquids from miscellaneous operations. The disposal of industrial waste water containing heavy metals was discontinued prior to November 19, 1980. These metals, primarily chromium, lead, mercury, and silver, are the main contaminants of concern and the reason for this investigation. High and low pH ion exchange regeneration solution discharges occurred up to 1985. However, these solutions were, for the most part, self neutralizing, and residue is not expected to be observed in this investigation.

Characterization data was collected at the IWD in support of a closure plan under a 1986 Resource Conservation and Recovery Act (RCRA) Consent Order and Compliance Agreement (COCA). Before the closure plan work was completed, the COCA was replaced by the current FFA/CO. This existing data has been reviewed and was used as a basis for preparing the RI/FS Work Plan.

The objective of the RI/FS is to assess the potential risk to known and suspected receptors from contaminants in the IWD and to evaluate and select the most appropriate remedial action alternative. The work required to meet these objectives includes the following items: performing geological and engineering surveys and mapping, installing and operating stream gauging equipment, installing shallow ground water monitoring wells, aquifer response testing, installing monitoring well water level recorders, and sampling and characterization of ground water, surface water, soil, and sediment.

A Work Plan has been developed that will ensure adequate data of sufficient quality is collected for this RI/FS. This data will be used to characterize the nature and extent of the contamination which is present in the IWD to support the risk assessment calculations and to evaluate the remedial action alternatives.

The IWD RI/FS process for the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) and the FFA/CO includes the completion of an RI/FS report and a proposed plan which summarizes the results of the investigation work and presents the proposed remedial action. Following a public comment period and resolution of comments received, a Record Of Decision (ROD) will be signed finalizing all remedial action plans associated with the IWD.

1.0 INTRODUCTION

This work plan provides the planned work activities associated with the completion of the RI/FS for the NRF Exterior Industrial Waste Ditch (IWD). The end product of the RI/FS process is a ROD for OU 8-07, NRF IWD. The RI/FS process encompasses two separate but related activities:

- Remedial Investigation (RI) - data development, site characterization and risk assessments

- Feasibility Study (FS) - development, evaluation and selection of remedial action alternatives

The objective of the RI is to collect and organize existing data, and collect, validate, and organize new data to provide a data base for risk assessment and remedial action selection and design. Based on the need to supplement existing data, this RI work plan describes the field work, laboratory work, data collection, interpretation, treatability studies and reporting that will be performed. Risk assessments are required at various steps in the RI/FS process. For the IWD, a Baseline Risk Assessment is proposed that will identify and evaluate the risks of the no-action alternative to human health and the environment. Various risk scenarios will be prepared for workers at the NRF and residents living near the INEL including:

- Future Occupational use
- Future Residential use
- Future Agriculture use
- Current Occupational use
- Ecological Exposure (terrestrial biota)
- Ecological Exposure (aquatic biota)

The Risk Assessment results will be used to support the evaluations of remedial action alternatives in the FS.

The FS will be conducted if the risks identified exceed the established thresholds (EPA 1991a). The purpose of the FS is to develop a remedial design that meets the requirements of CERCLA and the NCP. This study will use, as necessary, screening analyses, treatability studies, and engineering studies to identify, evaluate, and select the most appropriate remedial actions for OU 8-07.

The following is a description of the plans developed as part of the project planning and scoping task. These plans are prepared in accordance with guidelines presented in the EPA document Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA, 1988). For a detailed description of the tasks associated with each of the following sections, refer to the appropriate section or appendix of the same name.

1.1 Work Plan

The RI/FS Work Plan presents the initial evaluation and summary of existing data and information gathered in the scoping process. It documents decisions identified during project scoping and proposes activities to be conducted. The RI/FS Work Plan includes:

- A description of the site background and physical setting
- A discussion of previous investigations and current conditions, including a summary of existing data
- A discussion of risk assessment protocol and a preliminary conceptual model of the site
- A discussion of Work Plan rationale, including data quality objectives (DQO)
- A description of the Work Plan tasks to be performed
- A project description, including project management, organization, schedule and costs

1.2 Community Relations Plan

The Community Relations Plan (CRP) is designed to assure community understanding of action taken during the remedial response activities, and to obtain community input on the RI/FS program. Community relations are an integral part of any CERCLA action whether or not the action is on a federal facility.

At the INEL, all CERCLA actions will be subject to both CERCLA and National Environmental Policy Act (NEPA) community involvement requirements. CRPs have been written and provided for public comment for all remedial investigations at the INEL. The FFA/CO states that for each RI/FS, a CRP supplement will be issued. The CRP supplement for the NRF IWD RI/FS is attached as Appendix A to this Work Plan. The INEL CRP and the NRF IWD CRP Supplement will guide the actions taken to assure appropriate public involvement in agency decision making.

1.3 Sampling and Analysis Plan

The Field Sampling Plan (FSP), Quality Assurance Project Plan (QAPjP) and the Data Management Plan (DMP) are combined into a Sampling and Analysis Plan (SAP). The SAP identifies detailed procedures for the collection, analysis and control of environmental data. The SAP is presented in Appendix B to this document. The FSP presents the sampling objectives, the sample location and frequency, sample designation, sampling equipment and procedures, and sample handling and analysis. The FSP is divided into two major sections:

- Near surface and sediment sampling

- Hydrogeological investigations

The QAPjP presents the procedures that will ensure the quality and integrity of samples collected, the precision and accuracy of the analytical results, and the representiveness and completeness of environmental measurements taken. The QAPjP, written in accordance with current RI/FS guidance, includes the following elements:

- Project description

- Project organization

- Quality assurance objectives

- Sample collection procedures

- Sample custody procedures and documentation

- Calibration procedures and frequency

- Internal quality control procedure description or reference

- Data reduction, validation, and reporting procedures

- Performance and system audits

- Preventative maintenance procedures

- Specific routine procedures used to assess data accuracy, precision, and completeness

- Corrective action procedures

- Quality assurance reports including results of system and performance audits and assessments of data accuracy, precision, and completeness

The DMP provides a discussion of the procedures and controls that will be employed to ensure that the data collected will be properly managed. The DMP includes information in the following areas:

- Field activities

- Sample management and tracking

- Document control and inventory

1.4 Health and Safety Plan

The Health and Safety Plan (HASP) details the health and safety measures to be implemented in conducting RI/FS field activities at the site. It has been developed to assure the protection of personnel during RI/FS field activities. It includes a discussion on Personal Protective Equipment (PPE), the types of personnel monitoring techniques and instrumentation to be used, personnel contamination control procedures, medical surveillance requirements, and applicable safety procedures. The HASP, which includes the elements described in the "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities" (NIOSH/OSHA/USCG/EPA) and 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response", is presented in Appendix C to this work plan.

1.5 NEPA/CERCLA Integration

It is DOE's policy that all projects involving any federal facility must undergo a review in accordance with NEPA to identify and evaluate potential environmental impacts. The EPA does not necessarily support this position. To meet the requirements of NEPA and DOE Order 5440.IC, environmental documentation must be prepared for all new programs or research and development projects that have the potential for affecting the environment. Parts 1500 through 1508 of 40 CFR provide regulations applicable to all federal agencies for implementing the procedural provisions of NEPA. DOE has developed guidelines for its facilities to implement the provisions of NEPA. These guidelines require that DOE facilities determine the applicability of NEPA to various activities being undertaken. Under the DOE guidelines, three basic alternatives for documentation under NEPA exist: an Environmental Impact Statement, an Environmental Assessment, or a Categorical Exclusion. The choice of an alternative depends on the activity and its potential to impact the environment.

The RI/FS site characterization work for the IWD meets the requirements of a categorical exclusion under NEPA. The RI/FS site characterization work is covered by Section D part 3 of the Friday, September 7, 1990 Federal Register (FR) (Vol. 55, No. 174 page 37178) for site characterization and environmental monitoring under CERCLA. The RI/FS actions described in this Work Plan will not introduce or cause inadvertent or uncontrolled movement of hazardous substances as defined in section 101(14) of CERCLA, pollutants or contaminants as defined in section 101(33) of CERCLA, or non-native organisms, and will not adversely affect environmentally sensitive areas such as historic archeological, or areas listed on the National Register of Historic Places.

If, after the initial site characterization of the IWD, it is determined that remedial action is necessary, a NEPA evaluation will be performed for the remedial action. The NEPA evaluation will be integrated into the FFA/CO and CERCLA documentation. This integration will assure the proper assessment of the project and eliminate duplication of work.

2.0 BACKGROUND AND PHYSICAL SETTING

2.1 Description and History

2.1.1 INEL Description and History

The INEL site was established in 1949 as the National Reactor Testing Station by the U.S. Atomic Energy Commission as a site for building, testing, and operating various nuclear reactors, fuel processing plants, and support facilities with maximum safety and isolation. In 1974, the National Reactor Testing Station was redesignated as the INEL to reflect the broad scope of engineering activities conducted there.

The U.S. government occupied portions of the INEL prior to its establishment as the National Reactor Testing Station. During World War II, the U.S. Navy used about 270 square miles of the site as a gunnery range. An area southwest of the naval gunnery area was once used by the U.S. Army Air Corps as an aerial gunnery range. The present INEL site includes all of the former military areas and a large adjacent area withdrawn from the public domain for use by DOE. The former Navy administration shop, warehouse, and housing area is presently the Central Facilities Area of the INEL. Figure 2-1 depicts the location of the INEL relative to the State of Idaho and NRF relative to the INEL. Figure 2-2 depicts the location of the IWD channel with respect to the NRF.

2.1.2 NRF IWD Site Description

Naval Reactors Facility (NRF) is located on the west-central side of the INEL approximately 50 miles west of Idaho Falls, Idaho. NRF is operated by Westinghouse Electric Corporation for the United States Department of Energy, Naval Reactors. The facility covers an area of approximately 80 acres and, at various times, is occupied by up to 2000 people. In addition to the information provided in this section, Appendix F contains information on INEL and regional geology and hydrology.

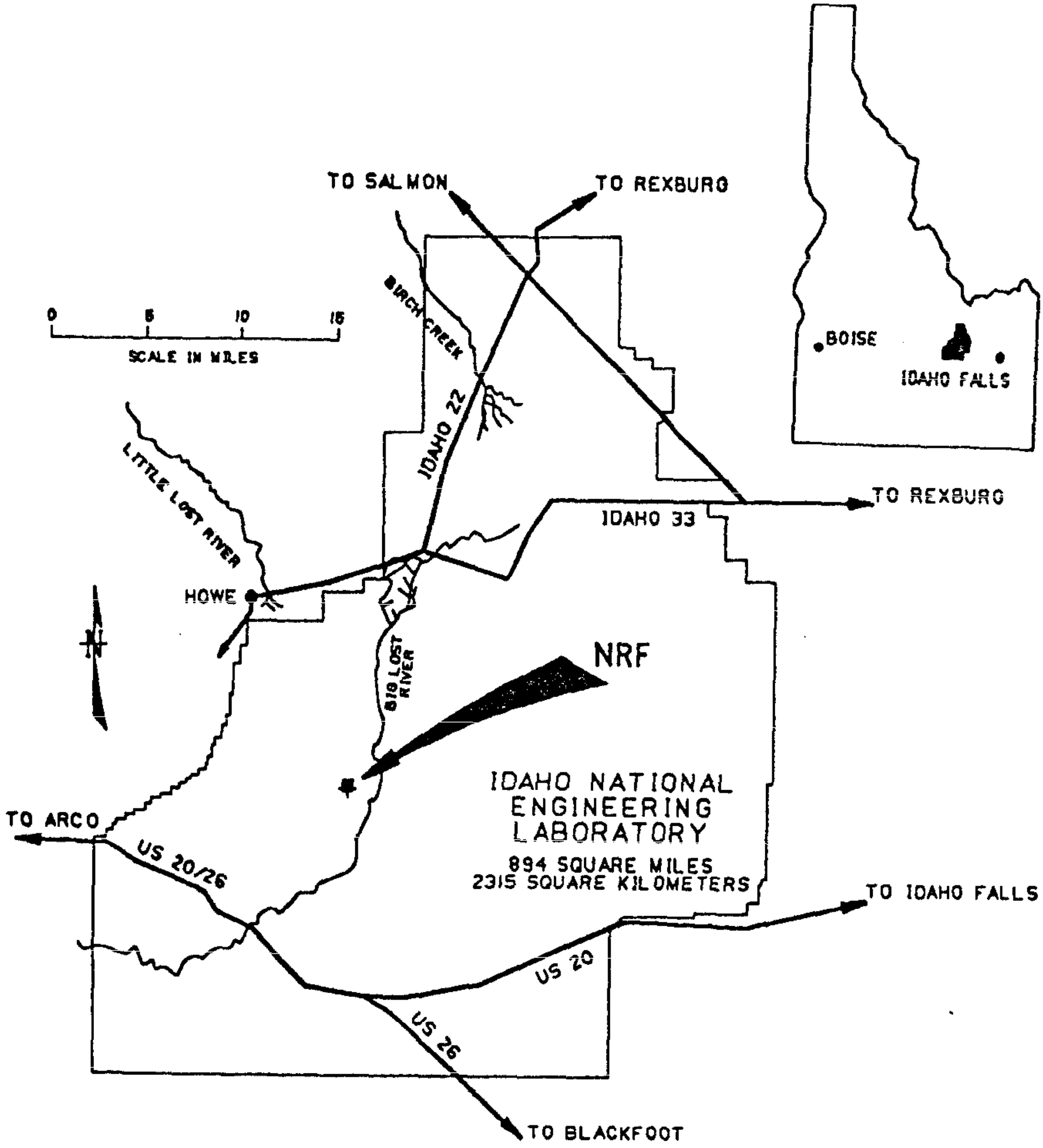


Figure 2-1 Location of the INEL and NRF Relative to the State of Idaho

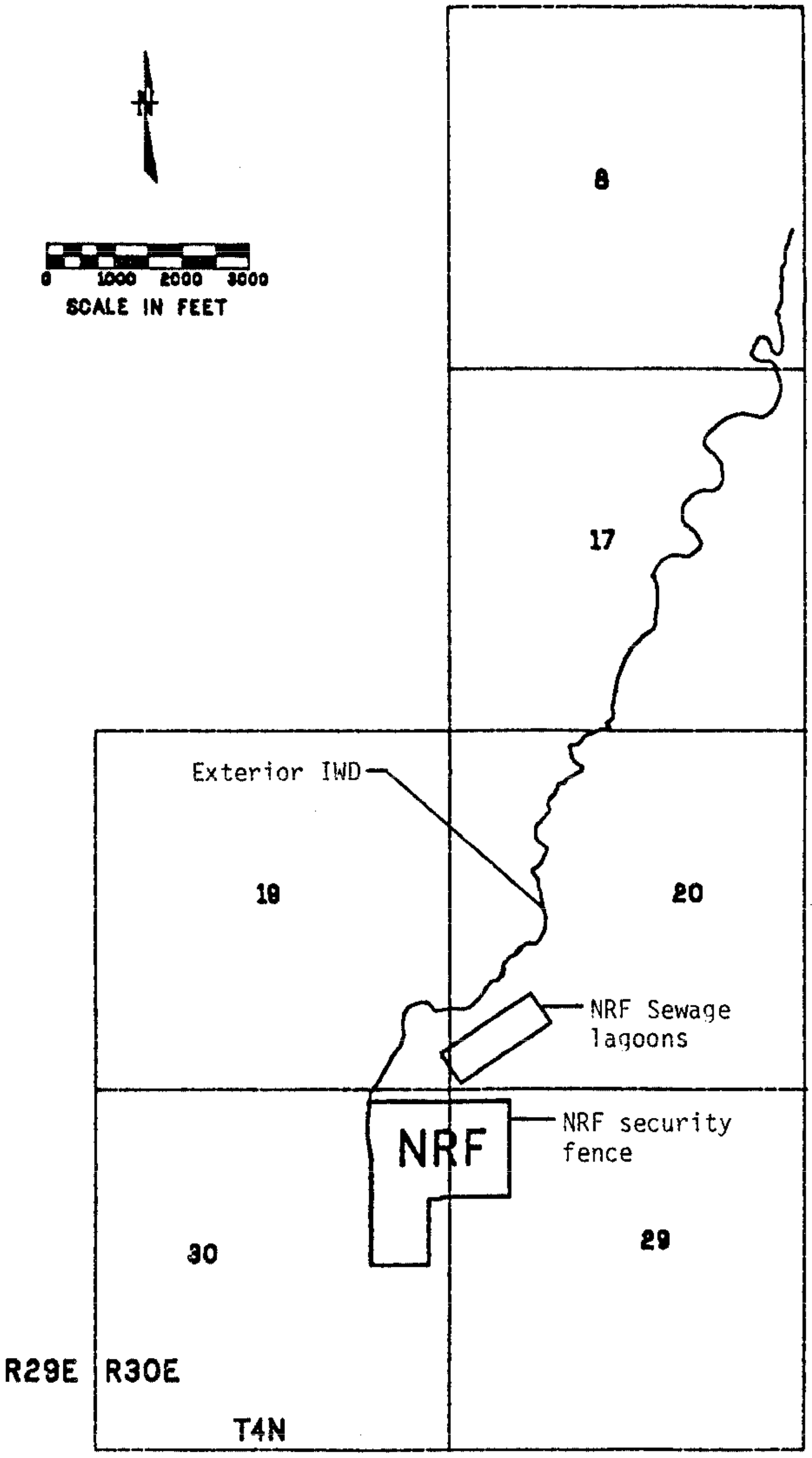


Figure 2-2 Location of the Industrial Waste Ditch with Respect to the Naval Reactors Facility

The NRF was established in 1949 as a testing site for the naval nuclear propulsion program. The Submarine Thermal Reactor Prototype (S1W) was completed and became operational in 1953. At this time, an industrial waste ditch was constructed to accommodate the disposal of nonradioactive, non-sewage, liquid discharges from the prototype and other support operations. This ditch consisted of a shallow open channel extending north from S1W for approximately one-half mile. Various run-off channels and pipelines were connected to the ditch. The end of the channel was slightly enlarged by excavation, forming a small pond or depression. NRF utilized the one-half mile long ditch for approximately two years. Construction activities at NRF since 1956 have destroyed all traces of this portion of the ditch. The land area once accommodating the old ditch has been replaced by a gravel pit and sewage lagoons.

In 1956, new construction to provide for a second prototype was initiated. In 1958, the Large Ship Reactor Prototype (A1W) was completed and became operational. At this time, the internal channels and piping were modified such that the effluent from both plants were combined at the northwest corner of the facility. The combined channel was then diverted into an old dry stream bed which proceeded towards the northeast, away from the facility. The selected dry channel was excavated for a short distance to secure containment of liquid waste disposed of within the channel, and to provide a waste water flow pathway away from the facility.

In 1965, the uncovered channel near the northwest corner of NRF was extended to allow flow to proceed further into the desert towards the northeast. This was necessary due to the addition of a third prototype reactor plant, S5G. Excavation to facilitate flow was terminated at approximately 1.65 miles along the channel. From 1.65 miles, the ditch proceeds along a natural river bed course to approximately 3.2 miles. At 3.2 miles, the channel abruptly ends against a canal bank constructed in the late 1800s.

From 1965 to the present, the exterior channel has remained intact with only slight modifications or changes. As discharges to the ditch increased, portions of the channel exhibited an insufficient percolation rate. In order to increase the percolation rate of liquid wastes through the ditch, portions of the exterior uncovered channel were periodically dredged. Wastes dredged from the channel were placed along the banks of the ditch. Dredging was conducted in the open channels along the west and north facility boundaries, and along the first 1.65 miles of the exterior uncovered channel northeast of the facility. Dredgings were conducted between 1973 and 1975, and in 1980.

The S1W reactor plant was shutdown and inactivated in 1989. No changes to the IWD were made at that time; however, there has been a noticeable decrease in water flow.

The current NRF effluent discharge system is a complex network of interior uncovered channels and buried pipelines approximately 24,000 feet (4.5 miles) long located within the facility and a 3.2 mile uncovered exterior channel located in the northwest corner of the facility and extending in a northeasterly direction. Water normally flows only in the first 1.2 to 1.8 miles of the channel; the remaining channel is usually dry.

The portion of the effluent discharge system outside the NRF Security fence is the subject of this RI/FS; the portion of the effluent discharge system within the NRF fenced boundary will be addressed under the provisions for Track 2 investigations and formalized in the NRF Site wide RI/FS.

2.2 Physical Setting (Geology)

2.2.1 Site Topography, Geomorphology and Physiography

NRF is constructed on an alluvial plain, the bulk of which was formed during wetter climatic periods. At present, the plain is experiencing a period of non-deposition. The alluvial plain surrounding NRF is punctuated by occasional outcrops of basalt. These outcrops rise to a maximum of approximately 20 feet above the surrounding desert floor. NRF is located slightly to the west of a series of low lying basalt outcrops which form a linear trend as shown in Figure 2-3. An arcuate-shaped ridge is visible at the surface north of NRF. This feature is reported to be a series of eruption vents (EG&G, 1984). These vents begin several miles west of NRF, but are not visible at the surface at NRF. The projected continuation of this trend intersects the IWD at nearly a right angle approximately 1100 yards from the outfall. Low lying, highly or moderately weathered basalt flows rising between 10 and 30 feet above the alluvial valley are located approximately 1/2 mile west of NRF. Beyond these low lying hills is the Lost River Mountain Range. These mountains rise in elevation to approximately 9000 feet. To the east of NRF, at a distance of approximately two miles, are low-lying hills, which are also a remnant of past volcanic activity.

Aerial photographs taken of the area surrounding NRF show a mosaic of abandoned meander channels. Several prominent features are evident in these photographs, including a number of point bar deposits and abandoned oxbows. A major abandoned meander channel is located approximately 600 feet due west of the IWD. This channel is 12 feet across and 6 to 8 feet deep. At the surface, abandoned meander channels are present in varying states of erosion. They range from hardly noticeable depressions in the soil to over six feet deep. The regional surface surrounding NRF gently dips to the north, and ranges in elevation from 4870 south of NRF to 4830 north of NRF. The elevation within the NRF compound ranges from 4848 feet to 4852 feet. Several man-made canals cross the desert terrain near NRF. The most prominent of these ditches lies approximately 1/4 mile north-northwest

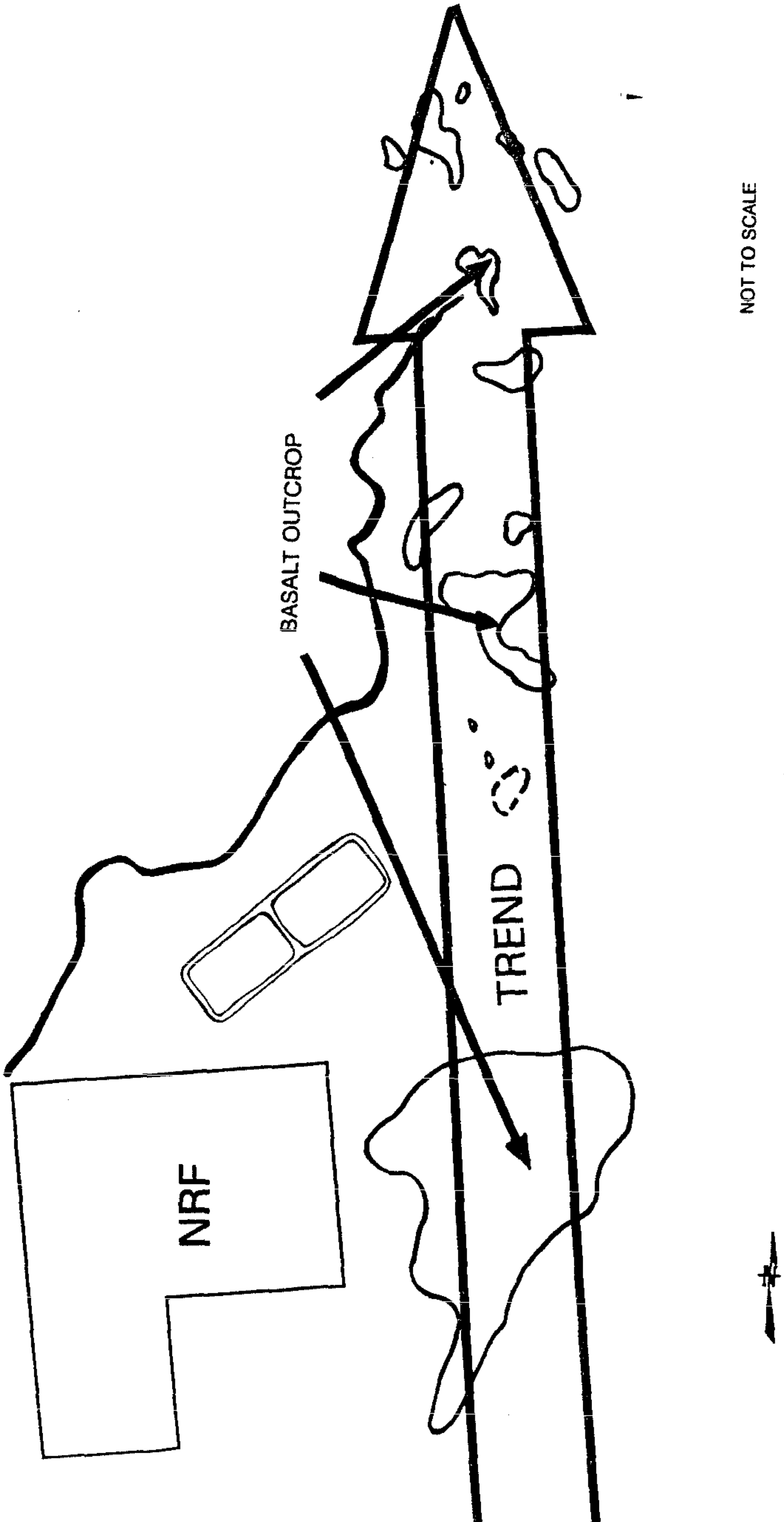


Figure 2-3 Line asalt Trends

of NRF. This canal is 20 feet wide and 15 feet deep. It rises above the desert floor 8 to 10 feet. Water no longer flows in the canal, and it is not expected to influence the hydrogeology of the IWD.

2.2.2 Area Geology

2.2.2.1 Near Surface and Surface Soils

There are two types of surficial sedimentary deposits common to NRF. The surface 'top soils' are loess deposits. Analysis of the loess shows that its primary constituent is the clay montmorillonite with secondary constituents of illite, quartz, feldspar and carbonates, (Chen-Northern Report, 1991). Montmorillonite is a swelling clay and possesses a high cation exchange capacity, (Deer et. al, 1978, p. 250). The thickness of the loess varies from several inches to over ten feet, (1984 EG&G report, 1987/88 Phase I Closure Plan Sample Collection report). In some isolated locations near NRF, winnowing has caused fine grain sand dune deposits to form. In most places near NRF, the loess and sand deposits overlie alluvial deposits.

NRF is located at the western edge of an alluvial (meander) plain. This plain is several miles wide and consists of well rounded gravels, sands, silts and clays. Most of the gravel clasts consist of a wide variety of rock types originating from the mountains located north and west of NRF, and include sedimentary, metamorphic and igneous (volcanic and plutonic) rocks. Clay and fine silt interbeds are found sporadically throughout the alluvium, but are more often found at the basalt/alluvium interface. These clay interbeds usually possess lower permeability than the surrounding gravel. Past geologic investigations have demonstrated that these clay layers often contribute to the formation of perched water at the top of the basalt.

2.2.2.2 Basalt

Underlying the alluvium is approximately 1500 to 2000 feet of transitional olivine to alkaline olivine basalts. Minerals present in thin section include magnesium olivine, clinopyroxene, calcic plagioclase, spinel and magnetite (Chen-Northern Report, 1991). Depth to the top of the basalt surface is as much as 60 feet. The basalt consists of individual flows ranging in thickness from five feet to over 70 feet. The intrinsic hydraulic conductivities of these basalts are generally in the range of 1×10^{-8} cm/sec.(Chen Northern Report). However, local fracturing greatly increases effective conductivity values. Most of the fractures in the basalt are probably the result of the cooling process.

The balance of the fractures may be the result of regional or local stress fields, although not enough data is available at this time to confirm this hypothesis. These fractures appear to be randomly distributed in the horizontal plane, but are concentrated at the top of individual flows. Some flows are virtually fracture free, while other flows are fractured from top to bottom. There is no evidence to suggest that one system of fractures cuts through all of the flows, thus providing an uninterrupted pathway to the aquifer. There is evidence to suggest that some portions of the basalt, perhaps occurring in quasi-linear trends, are more highly fractured than surrounding basalts. Though it is likely that such a trend would expedite surface water infiltration into the aquifer, it is doubtful that these 'fracture zones' act as conduits, allowing surface water to flow unimpeded from the surface directly to the aquifer.

2.2.2.3 Sedimentary Interbeds

Many of the individual basalt flows are separated by sedimentary interbeds. These interbeds differ in composition, thickness and areal extent, but they are almost always more permeable than the surrounding basalt. Past drilling at NRF has encountered a reddish colored sedimentary interbed occurring between 80 and 110 feet below land surface (bls). This red bed is widespread and ranges in thickness from less than six inches to over 14 feet. The sediments in this red bed are classified as lithic wackes and are generally poorly sorted mixtures of angular to subangular clasts.

The term lithic wacke was used by Chen Northern to describe specimens of immature sandstone with high clay content and the high presence of rock fragments other than quartz and chert (Chen Northern Original Laboratory Data, Appendix E-1, and Origin of Sedimentary Rocks). Dominant grain fragments are lithic basalt and quartz, with the finer constituents consisting of silt and clay. Figure 2-4 is a contour map of the top of this sedimentary interbed, including a Line A-A' near the IWD. Figure 2-5 shows a cross section along the Line A-A' depicting the thickness of the various strata underlying the IWD. Figure 2-6 is an isopach map of the same. The top of the red bed map shows that a prominent high exists northwest of NRF almost directly beneath the IWD. This high is bounded on either side by lows. The isopach map of the red bed roughly forms a series of quasi-linear ridges and troughs. Although the exact relationship is not well understood, perched water is frequently found in this sedimentary layer. However, the

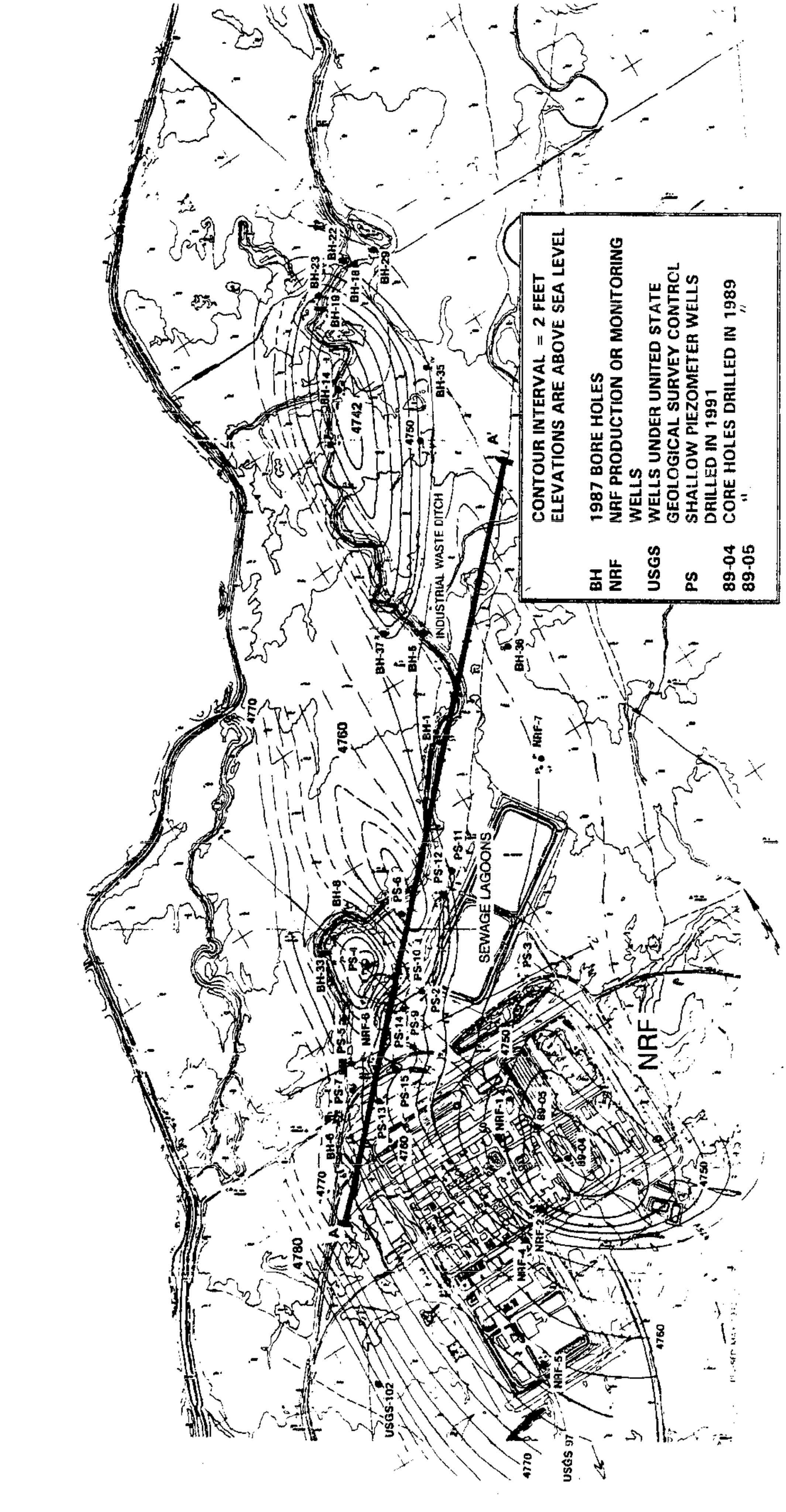
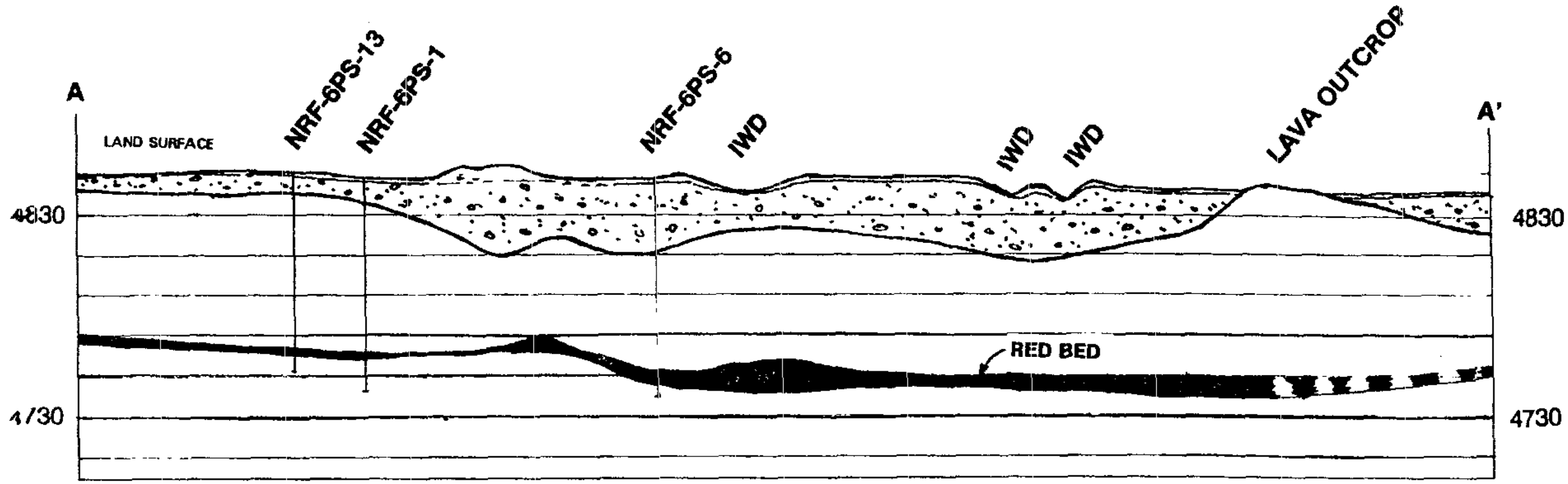


Figure 2-4 Contour - Top of Red Bed



HORIZONTAL SCALE 1" = 500'

VERTICAL EXAGERATION 5X

Figure 2-5 Cross Section of the IWD

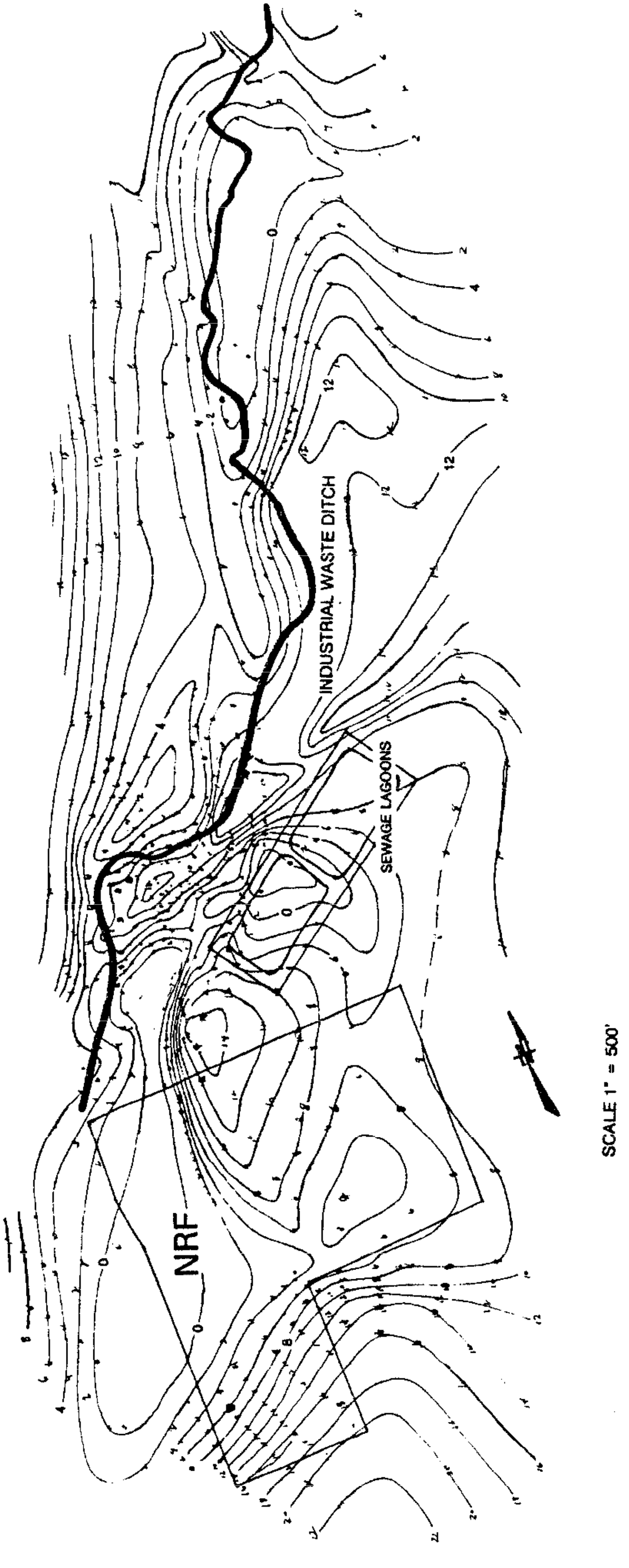


Figure 2-6 Isopach of Red Bed

actual perching layer appears to be a semi-impermeable basalt laying beneath the red bed. The red bed appears to act as a porous and permeable zone in which water accumulates and flows. It is speculated that this sedimentary may influence the flow direction of water in the perched zone. Other prominent interbeds occur at approximately 140 and 240 feet. To date, no conclusive evidence is available to suggest that these two deeper layers are commonly associated with the formation of perched water zones.

2.2.3 Area Hydrology

2.2.3.1 Snake River Plain Aquifer of Eastern Idaho

The entire eastern portion of the Snake River Plain, approximately 10,000 square miles in extent, is underlain by a vast groundwater reservoir known as the Snake River Plain Aquifer (SRPA). This aquifer is approximately 200 miles long by 30 to 60 miles wide, and is one of the largest aquifers in the world. The SRPA may contain over a billion acre-feet of water, and has been classified as a sole source aquifer. Stratigraphically, this aquifer consists of interbedded basalt flows, volcanic ash and sedimentary deposits of sand, gravel and clay. Evidence acquired from drilling suggests that the SRPA may be up to 10,000 feet thick.

The SRPA is divided into two stratified water bodies. The upper water body is 1500 feet thick, relatively new, and resides in highly fractured and highly permeable basalt. The lower water body is roughly 8,500 feet thick, and is approximately 35,000 years old (Barraclough, 1985). The basalt in this lower zone is less permeable than basalt of the upper zone. For this reason, most water production wells are completed in the upper water body.

The depth to the SRPA water table (piezometric surface) ranges from zero in some of the discharge spring areas to about 1000 feet a few miles southwest of the INEL. In general, water flow in the SRPA is from the northeast to the southwest. A large portion of the water contained in the SRPA flows towards the Snake River Canyon west of Twin Falls, where it is discharged from numerous springs in the canyon wall. These springs produces as much as 300,000 acre-feet of water annually. The average water table gradient across the entire SRPA is approximately 10 feet per mile. The yearly recharge and discharge to and from the aquifer is approximately 8 million acre-feet (Robertson, et al., 1974).

The greatest recharge to the aquifer results from the deep percolation of irrigation water onto the plain, as well as valley underflow from 35,000 square miles of recharge area in the mountains north and northeast of the plain (Lewis and Jensen, 1984). The transmissivity of the SRPA generally ranges from 1 to 100 million gallons per day per foot. The average transmissivity is about 5 million gallons per day per foot (Norvitch, 1969).

2.2.3.2 Snake River Plain Aquifer of the INEL

The SRPA beneath the INEL is characteristic of the aquifer in general. Depth to the top of the water table varies from 200 feet in the northeast corner to 900 feet in the southeast corner. Aquifer use at the INEL is restricted to production wells which provide drinking water and process water for reactor operations. The only significant natural recharge to the aquifer at the INEL is from the Big Lost River and Little Lost River. However, smaller amounts of recharge also occur from the infiltration of Birch Creek, and precipitation (during spring run-off). It is estimated that total natural recharge to the SRPA at the INEL is 400,000 acre feet. Man-influenced recharge through the use of waste disposal operations at different facilities also comprises a significant portion of the water mass balance at the INEL. IN 1984, 1.3 billion gallons of water were returned to the groundwater system through waste disposal activities, (IWMIS, 1984).

2.2.3.3 Piezometric Data

NRF is currently collecting water level data from approximately 14 nearby wells. These data have been compiled by NRF through 1991, and head distribution and flow direction maps have been constructed. These maps show that water flow direction in the vicinity of NRF has changed over time (see Figures 2-9, 2-10, and 2-11). In general, water in the SRPA flows from northeast to southwest, but locally the flow direction varies in response to local and regional recharge events. The main source of water flowing beneath NRF originates from sinks located at the terminus of the Little Lost River northeast of the INEL. Occasional flow in the Big Lost River also contributes water. During wet years, when water flows in the Big Lost River, a localized area of water mounding develops which causes ground water flow beneath NRF to shift to southwest. During drier periods, recharge from the Little Lost River Valley is predominant, causing ground water flow to shift to a more southeasterly direction. Because of cyclical changes in weather patterns, past ground water flow directions beneath NRF have oscillated between these two extremes.

2.2.3.4 Snake River Plain Aquifer at NRF

Many of the physical features common to the SRPA in general also apply to the SRPA beneath NRF. At NRF, the SRPA is located approximately 370 feet beneath land surface. Major recharge to the aquifer is assumed to come from the IWD and the sewage lagoons. Water is extracted from the aquifer via four production wells. Production from these wells range from 150 to 200 million gallons annually. Locally, water flow direction in the SRPA beneath NRF varies from southwest to southeast, depending on the relative contribution of recharge from the Big and Little Lost River. Preliminary data from wells NRF-6 and NRF-6P, completed in the SRPA, show that little or no vertical hydraulic gradient exits in this area. Long term data collection efforts will provide better information on this matter.

2.2.3.5 Recharge

The NRF IWD has been in operation for over 30 years, and has been the primary discharge site for non-sewage liquid industrial waste from NRF. The IWD presently occupies segments of two separate abandoned meander channels. Dredging has connected, widened and deepened these channels, forming the present IWD. The IWD is approximately 3.2 miles long; however, water flows only in the first 1.2 to 1.8 miles of the IWD depending on weather conditions and season. Discharge to the IWD ranges from 150 to 300 gallons per minute (gpm), or approximately 120 million gallons annually. Infiltration rates through the IWD channel may vary greatly. The IWD is built primarily on an alluvial plain which exhibits a widely varying degree of permeability. In some places, the IWD directly overlies potentially highly permeable basalt.

In addition to the IWD, the sewage lagoon also contributes to the aquifer recharge. NRF discharges its sewage and a small amount of storm water into evaporative sewage lagoons located northeast of the site. One lagoon is full year round and the other lagoon is used for overflow in the spring and early summer. An estimated 12 to 13 million gallons of water infiltrate through the bottom of the sewage lagoons annually. These figures are based on current flow records and estimated evaporation rates. In addition to recharge from the IWD and the sewage lagoons, infiltration from precipitation is also a source of recharge to the aquifer.

NRF lies on the north central edge of the eastern Snake River Plain (SRP). The SRP possesses a semi-arid climate, and NRF receives approximately 8.4 inches of precipitation annually. Warm temperatures, and short duration, low volume precipitation events minimize the amount of moisture infiltrating through the surface and eventually reaching the Snake River Plain Aquifer (SRPA) between the months of June and September. However, occasional heavy precipitation and snow melt in the spring also contribute to aquifer recharge.

2.2.3.6 Perched Water

During the summer of 1991, two deep monitoring wells and 15 shallow piezometer wells were drilled in the vicinity of the IWD. Six of these wells encountered perched water, the rest were dry. The depth at which the water was encountered varied from well to well, but generally increased with distance from the IWD. Figure 2-7 is a map of the location of these wells. These maps, in conjunction with Tables 2-1 and 2-2, show the final disposition of each well. Figure 2-8 is a contour map showing the top of the perched water zone. The dotted lines in Figure 2-8 represent the interpreted extent of the perched water zones.

Pump tests were performed on several of these perched water wells during November and December 1991. Well PS-5, which constantly demonstrated the highest head of all perched water wells was determined to have a transmissivity of 1.4 ft^2/day. Well PS-7 and PS-9 had a calculated transmissivity of 1 ft^2/day and 14 ft^2/day, respectively. Well PS-9 contains the most standing water and possesses the highest transmissivity value, even though it is furthest from the IWD.

During the drilling of well PS-6, water was first encountered at approximately 77 feet below land surface (bls). Since that time, the water level has fallen and stabilized at approximately 99 feet below land surface. No transmissivity values were calculated for wells PS-6 and PS-1 because insufficient water was encountered in these wells to perform pump tests.

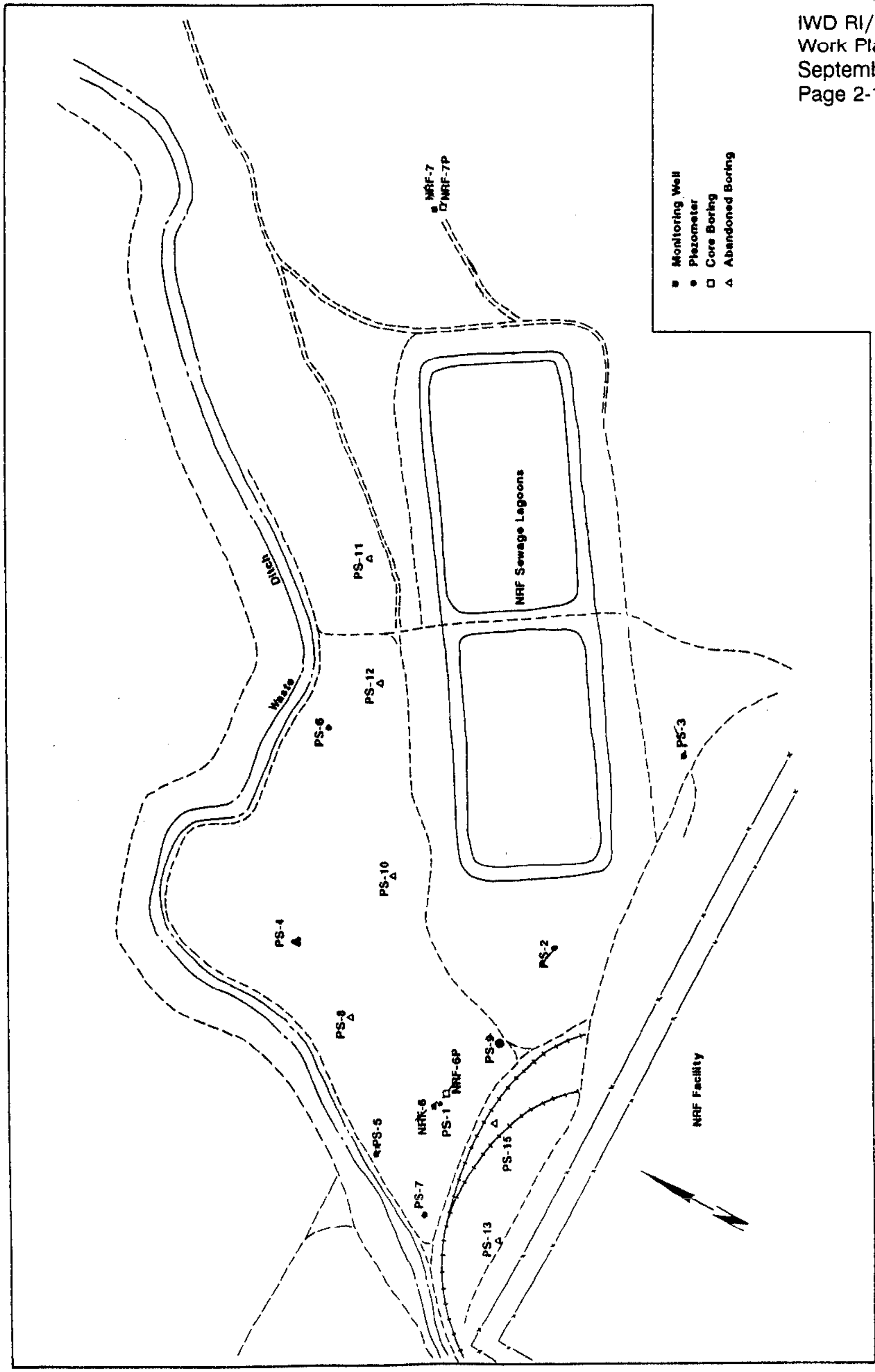


Figure 2-7 Location Map

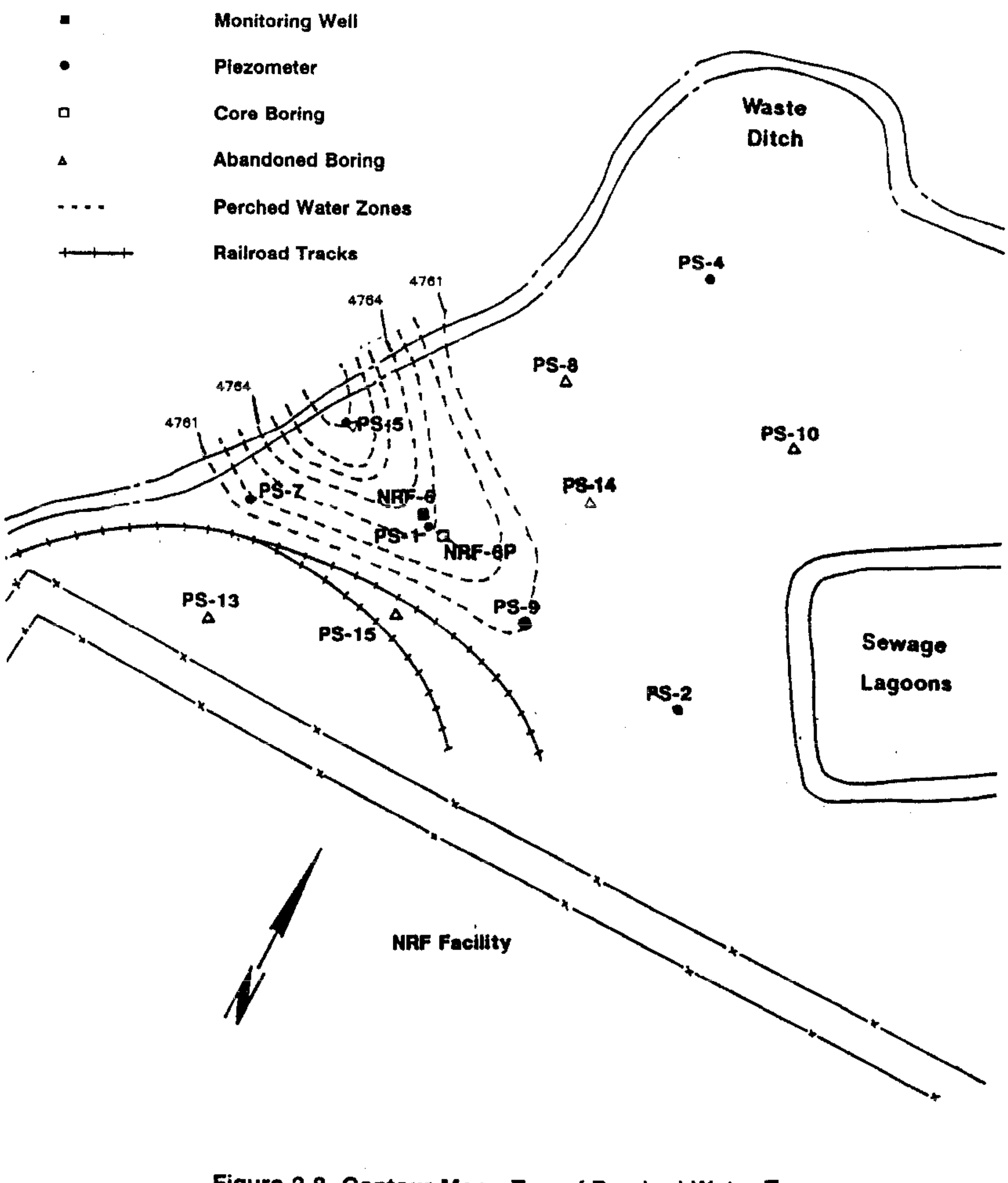


Figure 2-8 Contour Map - Top of Perched Water Zone

Table 2-1 NRF Well Completion Data

WELL ID	DATE INSTALLED/DRILLER	WELL DESCRIPTION	TOTAL DEPTH (FT)	GEOPHS. LOGS	ELEVATION OF LAND SURFACE	SCREEN INTERVAL
NRF-1	1950/A. A. Duran & Son, Walla Walla WA	PRODUCTION WELL	535 FT	G	4849.5*	394-478 483-530
NRF-2	1952/R. J. Strasser Co., Portland OR	PRODUCTION WELL	528 FT	G	4849.7*	373-397 422-448 497-523
NRF-3	1956/R. J. Strasser Co., Portland OR	PRODUCTION WELL	546 FT	G	4849*	485-543
NRF-4	1964/Cushman and Johnson, Idaho Falls ID	PRODUCTION WELL	600.5 FT	G	4849*	556-596
NRF-5	1963**/Cushman and Johnson, Idaho Falls ID	OBSERVATION WELL	1340 FT	G, GG, C	4849*	NA
NRF-6	1991/Jensen Drilling, Eugene OR	MONITORING WELL	437 FT	G, GG, N C, V	4847.64	359-417
NRF-6P	1991/Jensen Drilling, Eugene OR	CORE/ PIEZOMETER	500 FT	NONE	4847.56	484-489
NRF-7	1991/Jensen Drilling, Eugene OR	MONITORING WELL	435 FT	G, GG, N, C, V	4843.07	415-465
NRF-7P	1991/Jensen Drilling, Eugene OR	CORE/ ABANDONED	500 FT	NONE	4843.40	NA

* Data to 1/100 foot not available. These wells will be resurveyed to the nearest 1/100 foot.

** The well numbering system had not been initiated when these wells were drilled.

G - GAMMA N - NEUTRON C - CALIPER V - VIDEO D - DENSITY

DV - DEVIATION SP - SPONTANEOUS POTENTIAL R - RESISTIVITY

Table 2-2 Piezometer Well Completion Data

WELL ID	DATE INSTALLED/DRILLER	WELL STATUS	TOTAL DEPTH	GEOPHYS. LOGS	ELEVATION (FT)	SCREEN INTERVAL
PS-1	1991/Jensen Drilling, Eugene OR	Completed (Wet)	102 FT	G, C, V	4847.48	84-99
PS-2	1991/Jensen Drilling, Eugene OR	Completed (Dry)	115 FT	G, C, V	4847.08	92-102
PS-3	1991/Jensen Drilling, Eugene OR	Completed (Dry)	113 FT	G, C, V	4846.66	94-104
PS-4	1991/Jensen Drilling, Eugene OR	Abandoned (Dry)	96 FT	G, N, C, V, D, DV	4846.80	NA
PS-5	1991/Jensen Drilling, Eugene OR	Completed (Wet)	96 FT	G, N, C, V, D, DV, SP	4848.58	80-95
PS-6	1991/Jensen Drilling, Eugene OR	Completed (Wet)	105 FT	G, N, C, V, D, DV, SP	4846.33	87-102
PS-7	1991/Jensen Drilling, Eugene OR	Completed (Wet)	102 FT	G, N, C, V, D, DV, SP, R	4849.49	83-98
PS-8	1991/Jensen Drilling, Eugene OR	Abandoned (Dry)	95 FT	G, C, V	4847.90	NA
PS-9	1991/Jensen Drilling, Eugene OR	Completed (Wet)	113 FT	G, N, C, V, DV, SP, R	4847.78	89-104
PS-10	1991/Jensen Drilling, Eugene OR	Abandoned (Dry)	99 FT	G, C, V	4846.50	NA
PS-11	1991/Jensen Drilling, Eugene OR	Abandoned (Dry)	112 FT	G, N, C, V	4845.30	NA
PS-12	1991/Jensen Drilling, Eugene OR	Abandoned (Dry)	100 FT	G, N, C, V, DV, R	4845.90	NA
PS-13	1991/Jensen Drilling, Eugene OR	Abandoned (Dry)	99 FT	G, C, V	4849.60	NA
PS-14	1991/Jensen Drilling, Eugene OR	Abandoned (Dry)	97 FT	G, C, V	4847.70	NA
PS-15	1991/Jensen Drilling, Eugene OR	Abandoned (Dry)	126 FT	G, C, V	4848.00	NA

G - GAMMA N - NEUTRON C - CALIPER V - VIDEO D - DENSITY
DV - DEVIATION SP - SPONTANEOUS POTENTIAL R - RESISTIVITY

2.2.3.7 Interconnection of Recharge Sources and Perched Water

It is not clear how the sewage lagoon, the IWD and precipitation infiltration interact. Although it is likely that a perched water zone has formed beneath the sewage lagoon, no direct evidence is available to support this hypothesis. If this perched water body has formed, it is probably at a level near the red sedimentary interbed. A contour map of the top of the red bed based on drilling information shows that this interbed is widespread and varies in thickness (refer to Figure 2-6). Although the slope of this bed would suggest that some interaction between perched water from the IWD and the sewage lagoon should occur, insufficient evidence is available at this time to support this conclusion.

2.2.3.8 Discharge

Water leaves the SRPA at several locations. At NRF, water is extracted through four production wells. This water is used for plant cooling, drinking, and other domestic and industrial uses. A large of amount of water extracted by the wells is returned to the aquifer via the IWD and the sewage lagoons. Only water which evaporates or transpires prior to infiltration (including evaporation through the cooling towers) or that which is consumed is not returned to the aquifer.

The evaporation rate for NRF has been estimated to be between 36 and 40 inches per year. Transpiration accounts for an additional 6 to 9 inches per year. Estimates for the evaporation rate may be high because these figures assume a fully and constantly saturated surface. These figures suggest that approximately 2.1 million gallons of water is lost through evapotranspiration from the IWD annually.

2.2.3.9 Conceptual Physical Model

The geology beneath NRF is very complex and highly variable, therefore, a simplified physical conceptual model of subsurface geology has been constructed. The physical conceptual model described below depicts the major hydrogeologic elements of the IWD subsurface. This conceptual model will also be used in any future ground water computer modeling that will be performed for this operable unit.

Figure 2-12 is a generalized cross section of the IWD unsaturated zone and the upper portion of the SRPA, and is intended to depict the major elements of the simplified conceptual geologic model. This model is based on the results of the 1991 drilling activities, the 500 foot continuous cores that were recovered in 1989, and other investigations that were conducted in prior years. Water infiltrates slowly through the sediments of IWD channel, but the rate rapidly increases in the underlying alluvium. Several clay zones within the alluvium retard the downward infiltration of the ditch water and form 'moist zones'. At the surface of the basalt, another clay zone is encountered. Water from the IWD, possibly mixing with water from precipitation infiltration which is channeled to this location, forms a thin perched body. Water at this horizon spreads laterally until downward infiltration through the clay and the basalt reaches equilibrium with horizontal and vertical recharge. Downward infiltration through the basalt is generally slow compared to surface soils. Water movement occurs in a series of lateral and vertical steps. Some water flow occurs through the more permeable basalts, but the majority of the water moves laterally along flow boundaries until a vertical fracture is encountered. Water may follow these fractures for tens of feet before again repeating the process.

At approximately 90 feet, a red sandy sedimentary interbed is encountered. This interbed is underlain by a semi-permeable basalt which acts to retard the downward migration of water. A perched water body forms at this horizon and continues to spread laterally (down gradient) until the area of infiltration increases to a point where an equilibrium is reached between inflow and outflow. Since lateral variations in the number of fractures exists in the basalt, water in this perched zone may migrate down dip and abruptly resumes downward migration once encountering a more conductive zone. This same phenomenon causes these water bodies to assume irregular shapes. After passing this zone of perching, water continues its downward migration until the aquifer is reached.

Depending on the relative contributions of the various recharge points (high infiltration zones in the ditch, the sewage lagoons, etc.) a head distribution is created in the aquifer near NRF. This head distribution is influenced by the IWD, sewage lagoon, production wells and regional recharge to the area. This distribution is also influenced by differences in effective permeability in the basalt. The direction of flow in the aquifer is determined by the interaction of these factors. Contaminants in the water will be controlled by a variety of physical and geochemical parameters discussed previously in this document.

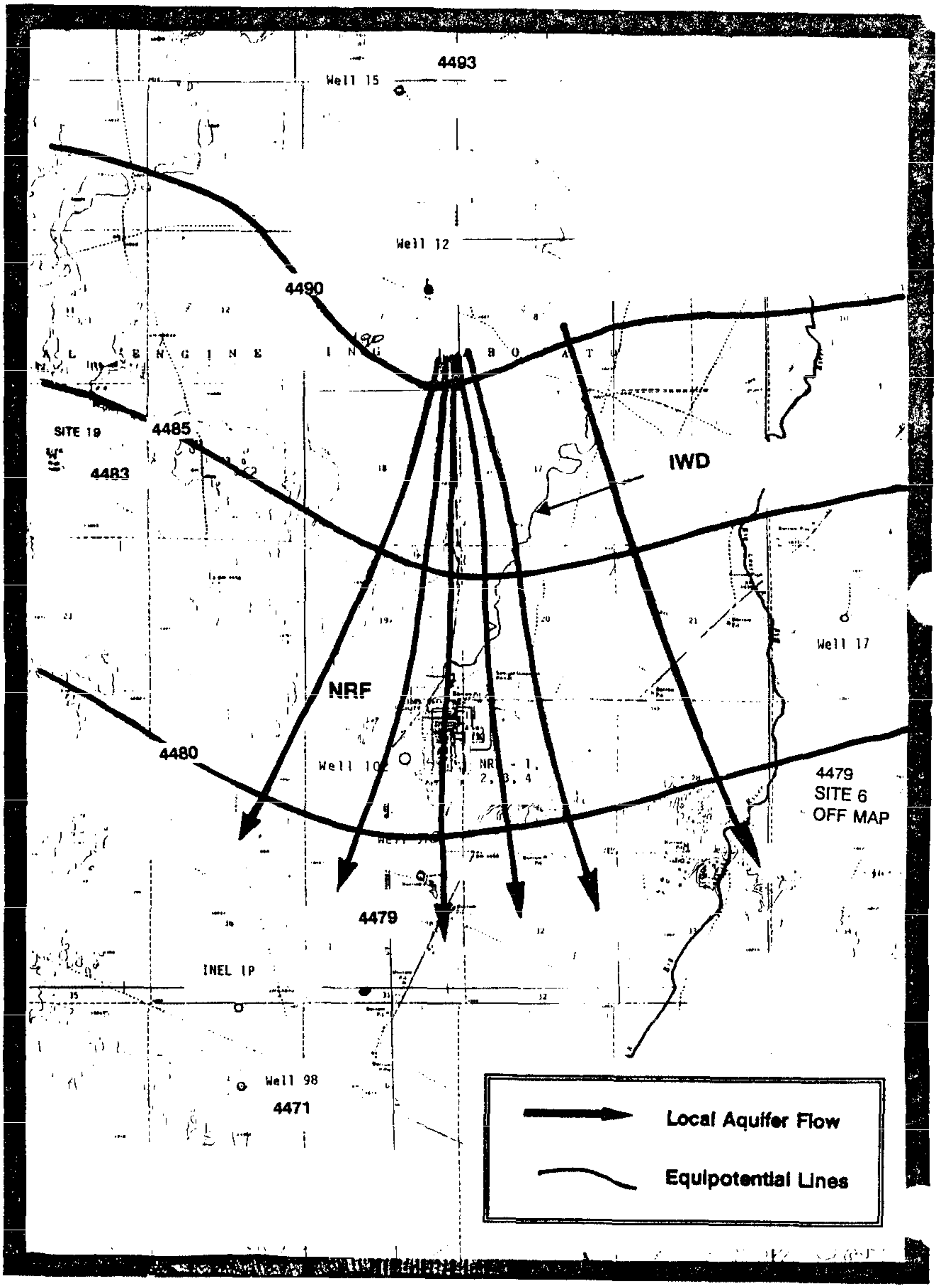


Figure 2-9 Apparent SRPA Flow Direction - July 1980

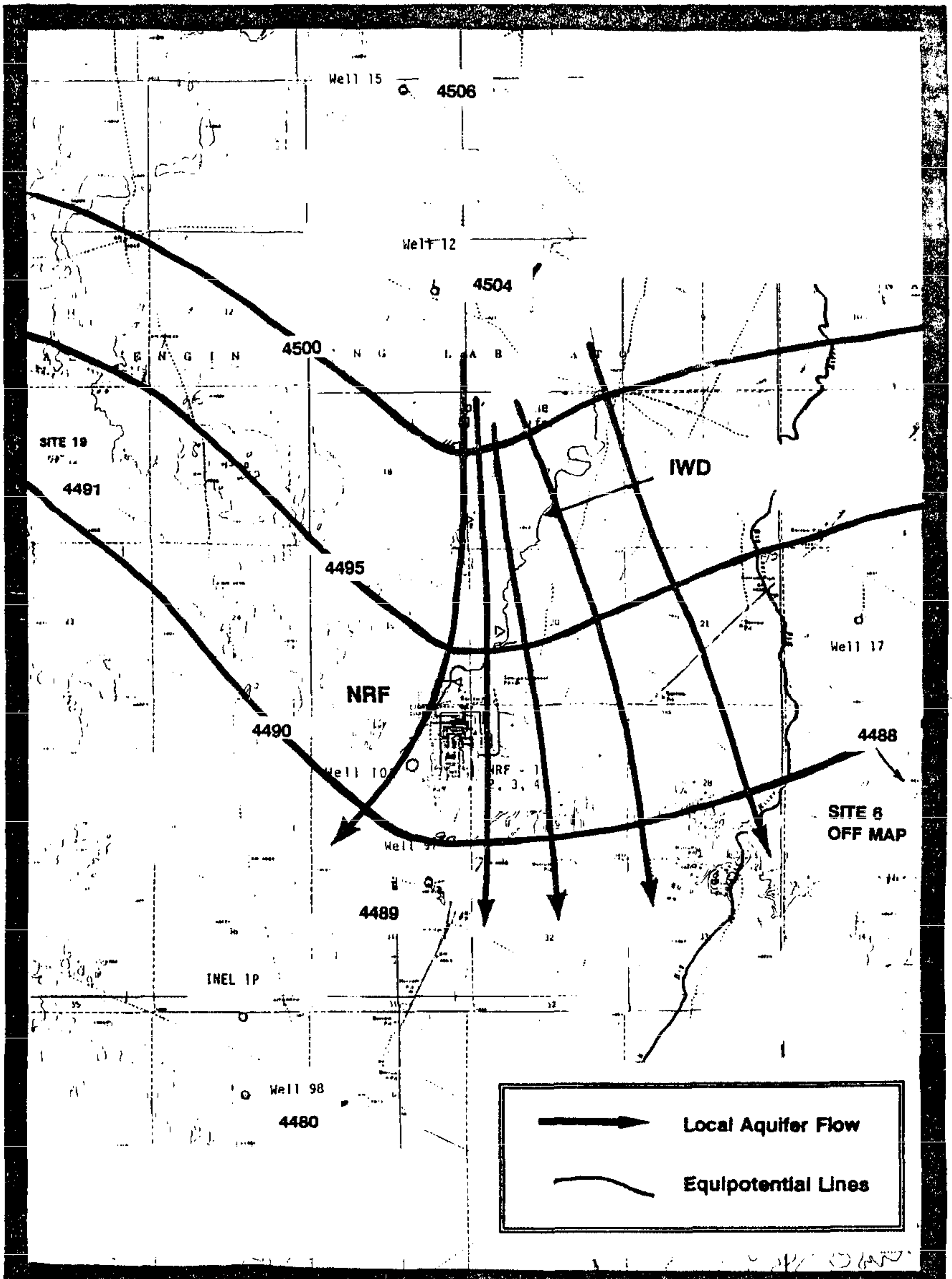


Figure 2-10 Apparent SRPA Flow Direction - July 1985

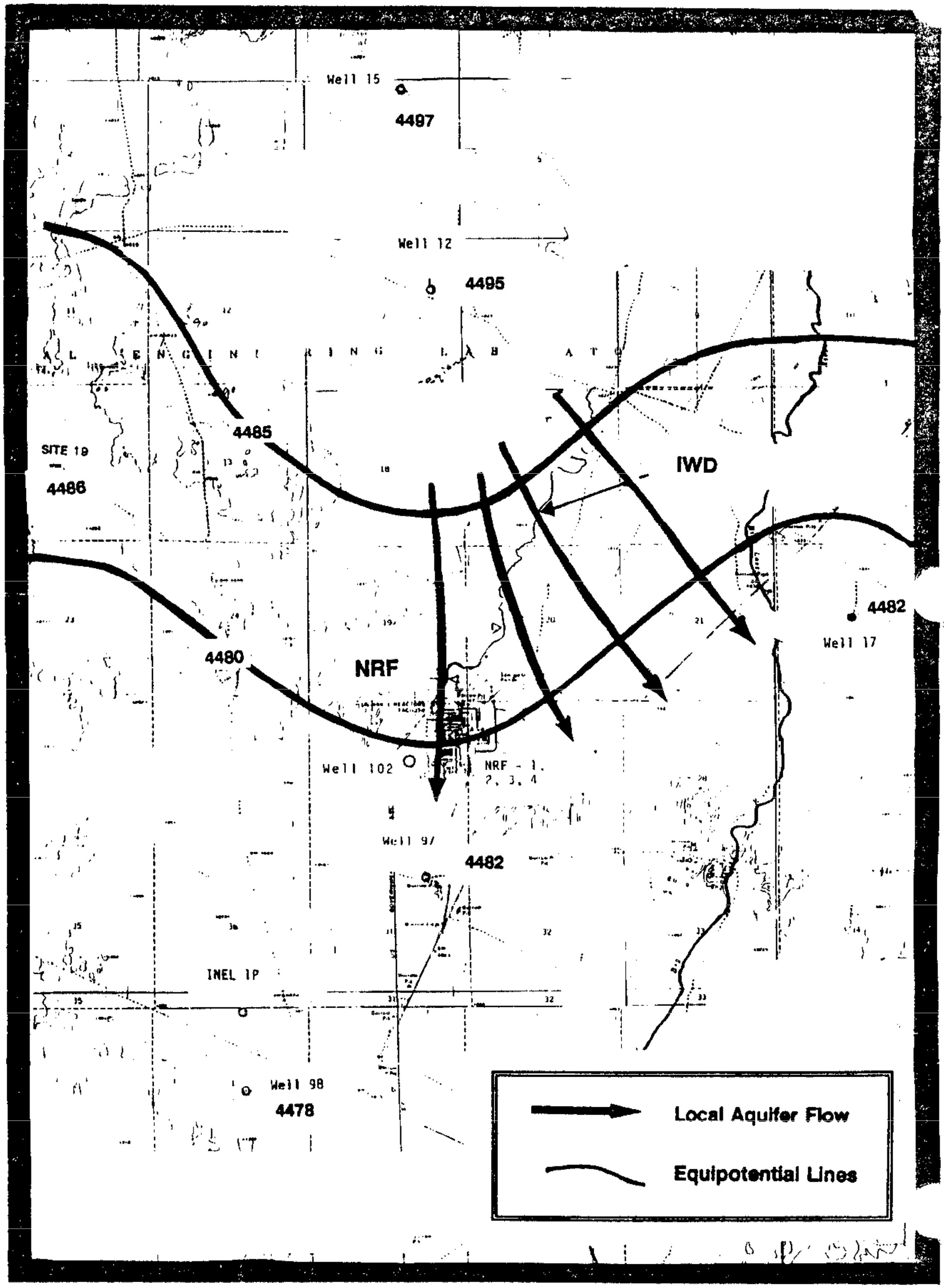


Figure 2-11 Apparent SRPA Flow Direction - July 1990

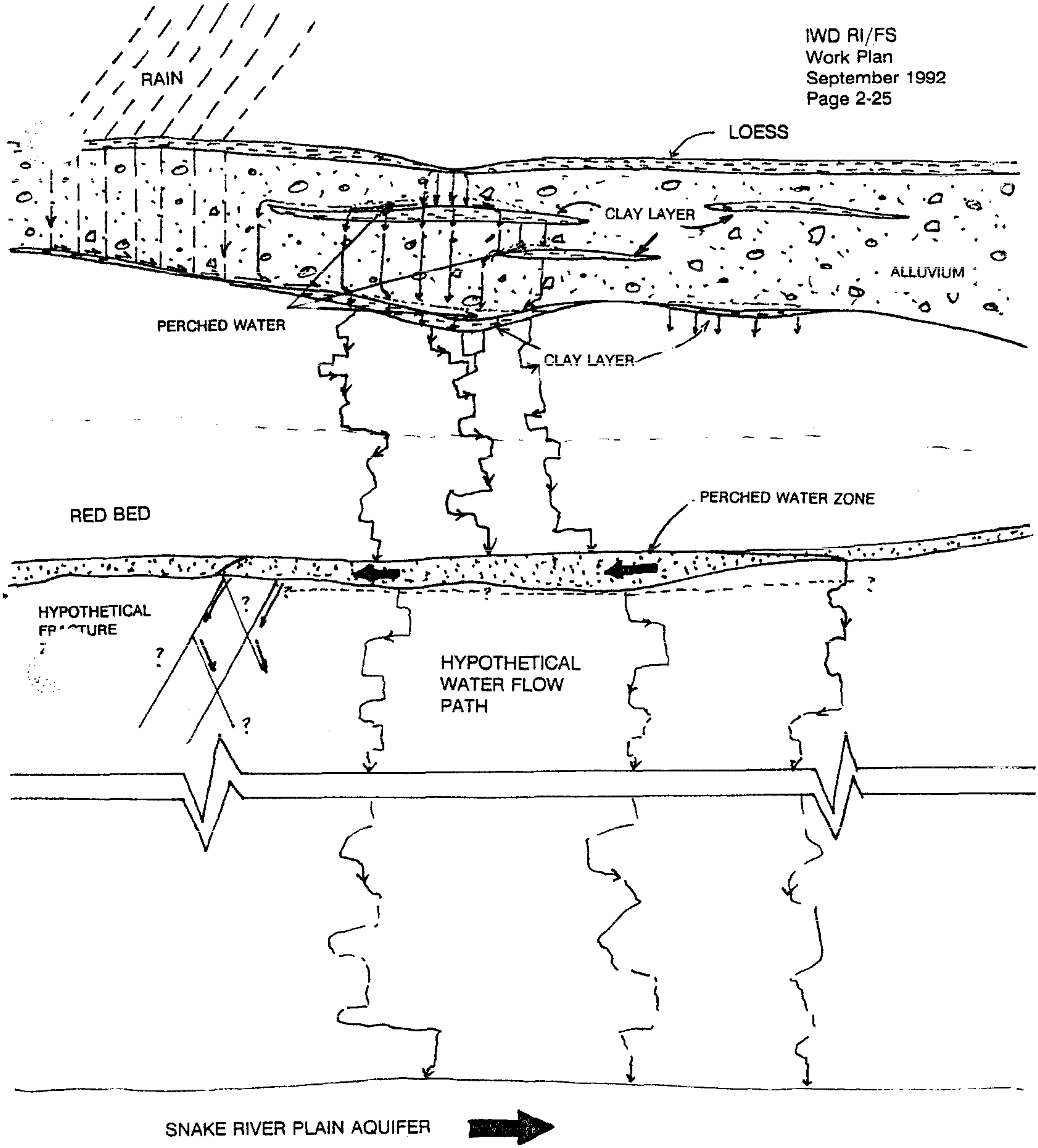


Figure 2-12 Generalized Cross Section of the IWD

2.3 Physical Characteristics

The surface of the INEL is a relatively flat, semi-arid sagebrush desert, with the predominant relief either as volcanic buttes jutting from the desert floor or as unevenly surfaced basalt flows and/or flow vents and fissures. Elevations on the INEL range from 5200 feet in the northeast to 4750 feet in the central lowlands; the average elevation is 4975 feet. Detailed site description, physical setting, and background information (i.e., geology, hydrology, meteorology, typical flora and fauna, etc.) are provided in Section 2.2 and Appendix F.

2.3.1 Disposal Categories and Flow Rates

Discharges to the NRF effluent disposal system began in 1953 and were composed primarily of rain/snow run-off, facility discharges containing occasional oily residues and some potentially hazardous constituents. The actual volumes and concentrations of discharges are unknown. However, sufficient data exists to establish typical annual discharges to the ditch occurring from 1953 to 1980 (26 years). Since 1980, the ditch has only been used for the disposal of non-hazardous industrial waste water. Table 2-3 identifies categories of discharges and estimated annual flow rates at the IWD outfall.

The information presented in Table 2-3 indicates an average flow rate of 205 gal./min. to the IWD. Recent visual observations and "bucket tests" indicate significant variations in daily flow rates based on prototype operating conditions. Collected data indicates flows as low as 30 gal./min. and as high as 300 gal./min. Current flows are expected to be approximately 150 gal./min. This lower flow rate (150 gal./min. versus 205 gal./min.) is a reflection of changes in operating conditions associated with the inactivation of the S1W prototype. The value presented in Table 2-3 falls within the expected range of flow rates.

2.3.2 Waste Identification

Table 2-4 identifies various chemical constituents used at the NRF during historical operations which may have been disposed to the IWD. It is uncertain if all the listed compounds entered the ditch network. An estimate of the total mass or volume of waste disposed to the ditch is also provided in Table 2-4. This estimate is based on procurement records, process knowledge, and plant operation records.

The constituents of concern associated with the operation of the ditch, as illustrated by the listing of chemicals in Table 2-4, are acids and bases (which are expected to have self-neutralized), trace organics (waste oil and solvents), and dilute solutions of heavy metals.

Table 2-3 Categories of Discharges and Typical Annual Flow Rates to the IWD (1953-1980)

Categories of Discharges to the Industrial Waste Ditch	Estimated Annual Flow Rate (Gallons/Year 1953-1980)
Run-Off (rain and snow melt)	33,000,000 *1
Prototype and Auxiliary Operations	70,000,000 *2
Cooling Systems	500,000
Ion Exchange Regeneration	4,000,000 *3
Laboratory Operations	1,000
Photographic Operations	1,000
	Total 107,503,000 (205 gal/min)

NOTES: *1 - Volume may range as high as 40,000,000 gallons
*2 - Volume may range as high as 79,000,000 gallons
*3 - Volume may range as high as 4,750,000 gallons

In 1980, NRF ceased discharging all RCRA wastes to the IWD except acid and base ion-exchange regenerant solutions which were self neutralizing. This change from previous practice was adopted as part of a general site improvement project and was accomplished by replacing hazardous chemicals with non-hazardous chemicals, collecting and properly disposing of remaining waste streams, and implementing waste control procedures. Discharge of acid and base ion exchange regenerant solutions continued from June, 1980 through March, 1985. In April 1985, a neutralization facility consisting of two 15,000 gallon neutralization tanks was installed. Acid and base solutions were mixed, neutralized, and discharged to the IWD. The optimal pH control level at the facility is between 6.0 and 9.0 pH units. Since April 1985, the IWD has received only rain/snow run-off, facility discharge containing oily residues (1 ppm), non-hazardous industrial waste water, and neutralization tank discharges containing a solution of acid and base neutralized to a pH between 6.0 and 9.0 pH units.

Table 2-4 Listing of Constituents Potentially Discharged from NRF Operations

Discharge Category	Constituents	Waste Concentration (*1) (ppm)	Total Mass Disposed (kg)
Run-Off From Rain/Snow	Unknown	Unknown (*2)	Unknown
Prototype Operations	Waste Oil	1	8600
	Disodium Phosphate	1	4900
	Trisodium Phosphate	0.01	810
	Sodium Sulfite	1	3300
	Sodium Chloride	324 (*3)	<180,000
	Hydrochloric Acid	12 Molar	Trace
	Surfactants	Trace	Trace
	EDTA Salts	Trace	Trace
	Waste Solvents (*4)	Trace	Trace
Cooling System Operations	Potassium Chromate (*5)	2,000	220
	Sodium Chromate (*6)	500	9500
	Calcium Hypochlorite	20	1100
	Mogul-PC122 (*7)	Trace	Trace
	Sulfuric Acid	12 Molar	Trace
Ion Exchange Regeneration Operations	Sulfuric Acid (*8)	12 Molar	8,900,000
	Sodium Hydroxide (*9)	6 Molar	2,300,000
	Sodium Chloride (*10)	34,000	36,000,000

Table 2-4 (Continued)

Discharge Category	Constituents	Waste Concentration (*1) (ppm)	Total Mass Disposed (kg)
Laboratory Operations	Barium Nitrate	Trace	Trace
	Lead Nitrate	Trace	Trace
	Mercuric Nitrate	10	<1.1
	Silver Nitrate	35	<3.8
	Benzidine Chlorides	Trace	Trace
	Chloroform	Trace	Trace
	Formaldehyde	1	<0.11
	Hydrazine	Trace	Trace
	Morpholine	Trace	Trace
	Hydrofluoric Acid	Trace	Trace
	Naphthylamine	Trace	Trace
	Phenol	Trace	Trace
	Pyridine	Trace	Trace
	Hydrogen Peroxide	Trace	Trace
	Nitric Acid	Trace	Trace
	Potassium Hydroxide	Trace	Trace
	Perchloric Acid	Trace	Trace
	P-Nitrobenzene	Trace	Trace
	Potassium Chlorate	Trace	Trace
	Potassium Nitrate	Trace	Trace
	Potassium Perchlorate	Trace	Trace
	Sodium Bromate	Trace	Trace
	Sodium Chlorate	Trace	Trace
	Zinc Nitrate	Trace	Trace
	Strontium Nitrate	Trace	Trace
	Aluminum Nitrate	Trace	Trace
	Calcium Nitrate	Trace	Trace
	Ferric Nitrate	Trace	Trace
	Magnesium Nitrate	Trace	Trace
	Potassium Bromate	Trace	Trace
	Ammonium meta-Vanadate	Trace	Trace
	Naphthalene Disulfonics	Trace	Trace
	Sodium Hydroxide	Trace	Trace

Table 2-4 (Continued)

Discharge Category	Constituents	Waste Concentration (*1) (ppm)	Total Mass Disposed (kg)
Photographic Operations (*11)	Ammonia	Trace	Trace
	Bromine	Trace	Trace
	Acetic Acid	10	<1.1
	Hydroxylamine Sulfate	Trace	Trace
	Phenyldiaminesulfate-R	Trace	Trace
	Formaldehyde	1	Trace
	Benzyl Alcohol	Trace	Trace
	Triethanolamine	Trace	Trace
	Potassium Hydroxide	0.004	Trace
	Potassium Carbonate	Trace	Trace
	Hydroquinone	0.004	Trace
	2,2-Iminodiethanol	3	Trace
	2-Aminoethanol	3	Trace

NOTES: - Trace concentrations denote values less than detection limits. Trace masses denote values less than 1 Kg.

(*1) - Waste concentrations shown are at point of generation; not at the outfall to the IWD.
(*2) - Waste constituents (if any) in run-off are unknown.
(*3) - Average concentration of Na and Cl ions.
(*4) - Waste solvents including chlorinated and fluorinated hydrocarbons, acetone, methanol, and toluene.
(*5) - Approximately 1,000 gal./yr.
(*6) - Approximately 500,000 gal./discharge between 1958 and 1967 at a rate of one discharge per each two years.
(*7) - Mogul contains polyphosphates, phosphine, and benzyltriazile.
(*8) - Approximately 2,000,000 gal./yr.
(*9) - Approximately 2,000,000 gal./yr.
(*10) - Approximately 744,000 gal./yr.
(*11) - These operations are similar to typical photographic operations associated with film development.

Since 1953, routine radiological monitoring of process water, cooling water, effluent water, and buildings and grounds has been performed at NRF. Currently, water samples are collected weekly from the IWD and other discharge locations, and analyzed for gross gamma radioactivity using gamma spectrometry. All samples collected for non-radiological analysis are screened for radioactivity using a gamma detector prior to leaving NRF. Additionally, radiological surveys are performed along the IWD, and sediment, soil, and vegetation samples are collected and analyzed for gross gamma radioactivity on an annual basis from five locations in the interior and exterior IWD. Cobalt-60 and Cesium-137 are the predominant radionuclides identified during this analysis, albeit at low levels as exemplified in Table 2-5. Cobalt-60 results from wear products from reactor plant equipment. Cesium-137 is the second most prevalent radionuclide found during routine monitoring, and is consistent with INEL background levels resulting from atmospheric weapons testing fallout. These two radionuclides are used to assess the presence of radioactivity during environmental monitoring at NRF, since they are easily detectable and are present with other NRF isotopes.

Systems which contain radioactive liquids (e.g. reactor coolant, radiochemistry laboratory liquid discharge) with beta, gamma, and alpha emitting radionuclides, are physically isolated from those systems discharging to the IWD. At NRF, water containing radioactivity is contained in separate, monitored systems which are isolated from those carrying other site effluents. Water containing radioactivity is collected, processed to remove the radioactivity, and reused rather than discharged to the environment. The reuse process systems include collection tanks, particulate filters, activated carbon columns, and/or mixed bed ion exchange columns to remove radioactivity from the water. Strict operational procedures have been used from the start of operations at NRF to control the release of radioactive materials. The results of sediment, soil, and vegetation samples collected from the IWD confirm that these procedures have been effective in keeping radionuclides from being discharged into the IWD, and that additional radioactivity sampling is not necessary.

Table 2-5 provides a summary of the 1991 soil, sediment, vegetation, and water samples. Screening levels for soil and water are also listed. Water screening levels are taken from the 10 CFR 20 Appendix B Table 3 limits for radioactivity in effluent to unrestricted areas. The Cesium-137 screening limit for soil is taken from the INEL Track 1 Guidance Document, which lists this concentration as typical of fallout from atmospheric weapons testing. While no specific Cobalt-60 screening level is listed, the Cesium-137 screening level may be used for comparison. Cobalt-60 has a much shorter halflife than Cesium-137, and its dose conversion factors for external and internal exposure are comparable to Cesium-137. All of the sample results from the IWD are less than the screening levels. In addition, Cobalt-60 and Cesium-137 concentrations are less than the total concentration of naturally occurring radionuclides in soil and sediment.

Analytical quality control (QC) to assure accurate and precise radioanalytical results is provided by an interlaboratory quality assurance (QA) program between the Bettis Atomic Power Laboratory (Bettis) in Pittsburgh, Pennsylvania and NRF Chemistry. This QA/QC program includes written analytical procedures, internal and external audits, performance evaluation sample analysis, and split sample analysis by outside laboratories (EG&G and Idaho Chemical Processing Plant).

Table 2-5 Summary of Routine Radiological Monitoring at IWD in 1991

	Soil (1) (pCi/gm)			**Sediment** (pCi/gm)		**Vegetation** (pCi/gm)		**Water** (2) (10^{-8} uCi/ml)		
	MEAN	MAX	SL	MEAN	MAX	MEAN	MAX	MEAN	MAX	SL
Cobalt-60	<0.1	0.22	(3)	<0.38	1.18	<0.36	<0.52	<5.5	<5.9	300
Cesium-137	0.25	0.49	1.3	0.36	0.60	<0.18	<0.26	(4)	(4)	(4)

pCi/gm Picocurie (10^{-12} curie) per gram
SL Screening level

(1) < in front of a maximum value signifies LESS THAN the minimum detectable activity (MDA). A mean value preceded by < contains at least one value below MDA.

(2) Water samples are analyzed for all gamma rays with energies between 0.1 and 2.1 MeV. This energy range includes Cobalt-60, Cesium-137, and a wide variety of other radionuclides of both natural and man-made origin. The concentrations shown for Cobalt-60 are less than the minimum detectable concentrations for the analysis, assuming all gamma rays detected had come from that one radionuclide.

(3) While no specific screening level for Cobalt-60 has been established, the Cesium-137 screening level may be used for comparison, since Cobalt-60 has a much shorter halflife and comparable dose conversion factors for both internal and external exposure.

(4) Cesium-137 is included in the equivalent Cobalt-60 concentration discussed in (2).

2.3.3 Process Input Locations and Characteristics

Figure 2-13 identifies known waste water input locations to the effluent discharge system network. Table 2-6 lists processes at each input location discharging waste water to the IWD and characterizes categories of wastes associated with each process. Various waste streams were combined in the buried culverts along the north and west facility boundaries. Waste water discharges are combined and mixed by the time the flow reaches the IWD outfall.

Table 2-6 Processes and Categories of Wastes at Identified Input Locations to the Effluent Discharge Network

Input	Waste Source
1	S5G cooling tower blowdown, storm water runoff
2	S5G sump water drain, bilge water drain, boiler blowdown, hull basin drain line
3	Facility runoff
4	S5G steam generator blowdown, S5G oil/water separator effluent
5	Facility storm water runoff and A1W oil/water separator discharge and steam generator blowdown
6	Facility runoff, condensate ion exchanger regenerant solutions, boiler blowdown
7	QC photography lab waste, S1W spray pond blowdown, S1W oil/water separator, S1W steam generator blowdown
8	Facility runoff
9	Facility runoff
10	Facility runoff

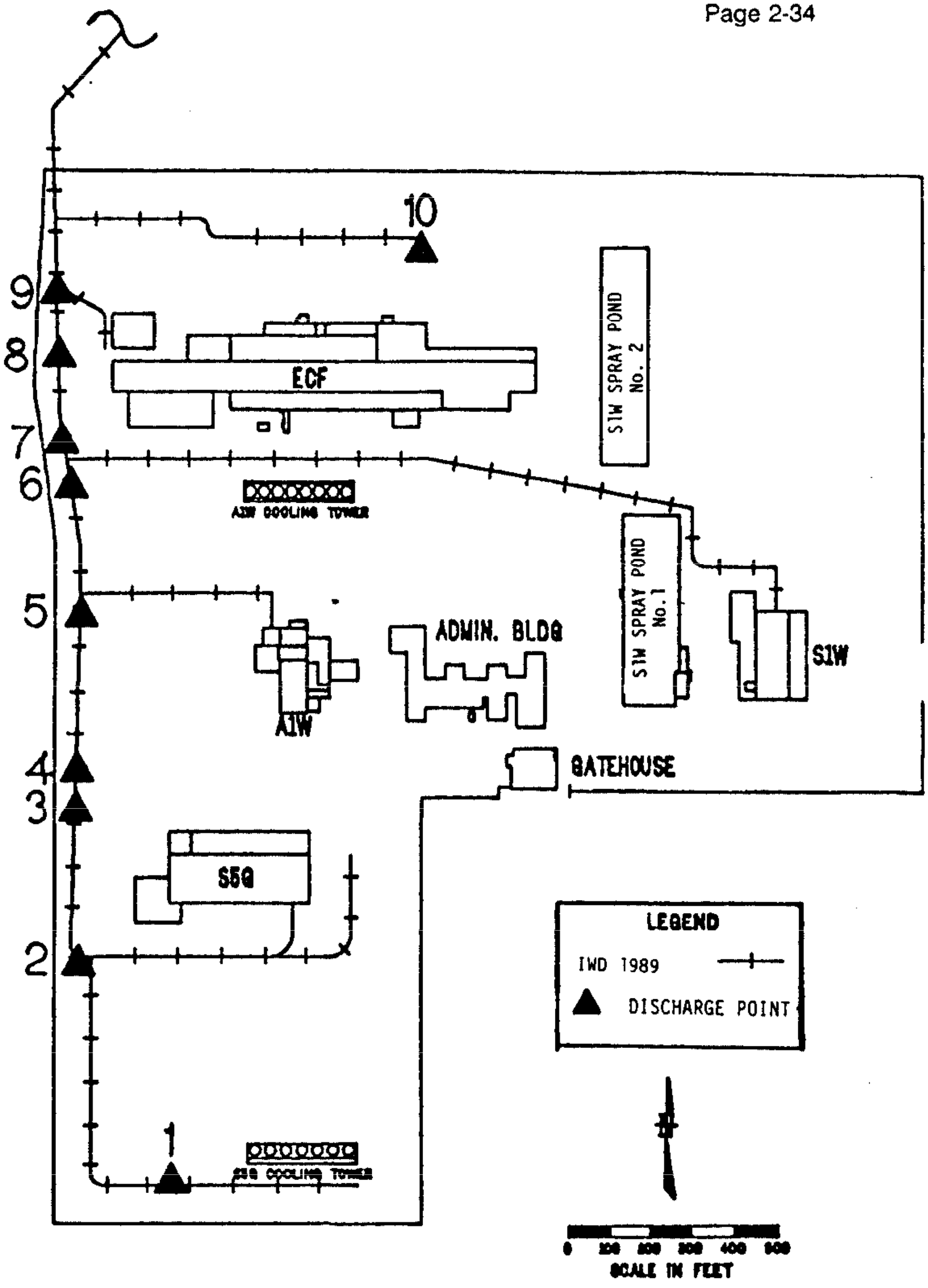


Figure 2-13 Waste Water Input Locations to the Effluent Discharge Network

2.4 Overview of Previous Investigations

The DOE and EPA signed a Consent Order and Compliance Agreement (COCA) to begin investigations and corrections of environmental problems at the INEL under the RCRA. Implementation of the COCA started in 1986. During development of the COCA, NRF collected a series of samples from the Interior Ditch System along the west side of NRF as part of the security fence upgrade. Under the provisions of the COCA, the investigation and closure of the IWD was to be performed in phases. Phase I activities consisted of an initial site characterization (sampling of the IWD and borehole studies), the preparation of the Phase I Closure Plan, and the 1987/88 Closure Plan Sample Collection Project, which performed soil sampling and analysis recommended by the Phase I Closure Plan. The Phase II Closure Plan summarized the results of the Phase I sampling activities and outlined the next phase of sampling. This included a Plant and Algae Study, a Ground Water Monitoring Program, and Well Drilling and Hydrogeologic Investigation. Sections 2.5 through 2.8 provide the descriptions and results from all of these COCA and pre-COCA investigations.

2.5 Initial Sediment Characterization Sampling Results

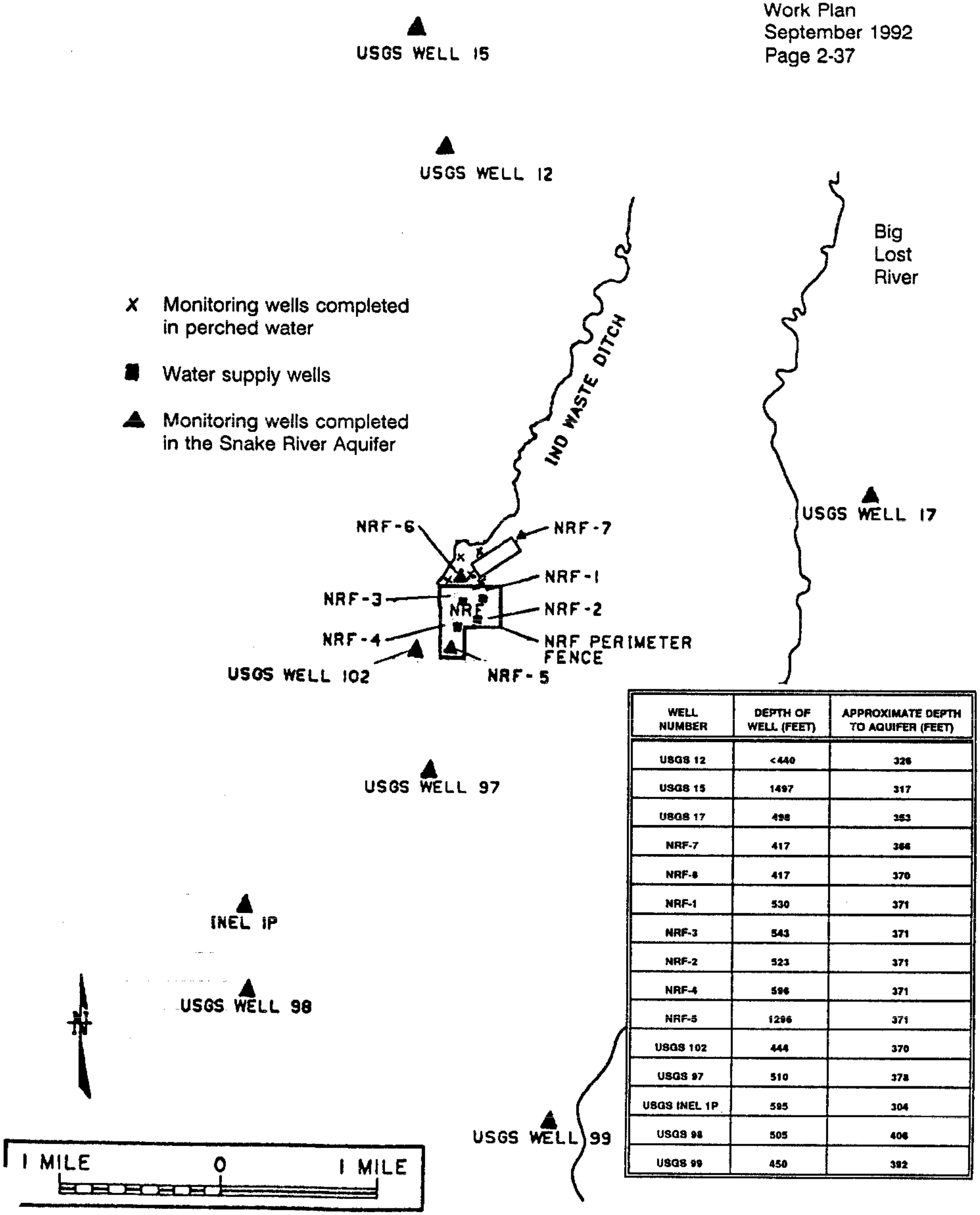
In 1985, NRF collected and analyzed sediment samples from the IWD for the first time. The results of this study formed the outline for the sediment samples collected in 1986. Detailed characterization sampling of the IWD was initiated in 1986. This sampling was considered necessary since the IWD was the final receptor for all industrial waste water produced at the NRF. From this perspective, this part of the effluent discharge system network was considered to be the "worst case" scenario with respect to disposal of industrial waste water and potential contaminant migration. The data collected during this effort was originally presented in the Phase I Closure Plan, and is summarized in Sections 2.5.1 through 2.5.3.

2.5.1 Sediment Samples (1985)

In October 1985, soil core samples were collected from the interior uncovered portions of the industrial ditch immediately bordering the north and west facility boundaries. These samples were collected in conjunction with a security fence upgrade and prior to the installation of a culvert along the west side of NRF which is currently between the two security fences. Samples were collected in order to identify the types of contaminants present within this portion of the interior industrial ditch network. Both vertical and lateral cores were collected from the top 15 inches of the ditch surface or embankment, and from several background locations near the facility. Following extraction or removal, each core was divided into five separate three inch segments or samples. The samples were analyzed by NRF chemistry department using digestion method 3050 from Solid Waste (SW) 846 second edition July 1982. Analyses methods 7190 for chromium with a Method Detection Limit (MDL) of 5 ppm and method 7761 for silver with an MDL of 0.5 ppm. Figure 2-15 identifies specific core locations along the channels bordering the facility. Individual samples from each core were analyzed for total chromium and silver content since previous operating data had indicated that relatively higher levels of these two constituents could be present in the ditch. Tables 2-7 and 2-8 present the analytical results of samples analyzed for chromium and silver, respectively. Background samples were collected.

2.5.2 Shallow Sediment Samples (1986)

In October 1986, 12 shallow sediment samples were collected from the uncovered exterior portion of the ditch extending northeast from the facility. Figure 2-16 illustrates the exterior uncovered channel and the locations where shallow sediment samples were collected. Data suggested that chromium, due to the mass placed in the IWD, would be the principal constituent of concern. The 12 samples were collected between the outfall and the end of the ditch, 3.2 miles from the outfall, and were analyzed for total chromium. Background samples were not collected during this sampling session. Visual observations revealed that liquid discharges did not flow the entire length of the IWD, but percolated into the ground within approximately 10,600 feet (two miles) from the outfall. Different zones of "contamination" were also visible along the length of the ditch containing liquid waste. The first 5,800 feet of the ditch were characterized by flowing surface water approximately 18 inches deep, visible oily sheen on the surface of the waste stream, oily sludge on the channel bottom, and few species of plants growing near the water's edge. The section of the ditch from 5,800 feet to 9,000 feet was characterized by slow flowing liquid effluent, 24 to 60 inches deep, visible oily sheen on the surface of the waste stream, no oily waste on the channel bottom, and dense vegetation growing near the water's edge. The section of the channel from 9,000 feet to 10,600 feet was characterized by a shallow, slow flowing liquid effluent, no visible oily sheen on the water surface, and dense vegetation near the water's edge, as well as a variety of aquatic organisms. The water flow ended at approximately 10,600 feet. In general, visual observations suggested that oily waste was only present along 9,000 feet of the 16,900 foot ditch.



WELL NUMBER	DEPTH OF WELL (FEET)	APPROXIMATE DEPTH TO AQUIFER (FEET)
USGS 12	<440	326
USGS 15	1497	317
USGS 17	498	353
NRF-7	417	366
NRF-6	417	370
NRF-1	530	371
NRF-3	543	371
NRF-2	523	371
NRF-4	596	371
NRF-5	1296	371
USGS 102	444	370
USGS 97	510	378
USGS INEL 1P	595	304
USGS 98	505	406
USGS 99	450	392

Figure 2-14 Monitoring Wells Near NRF

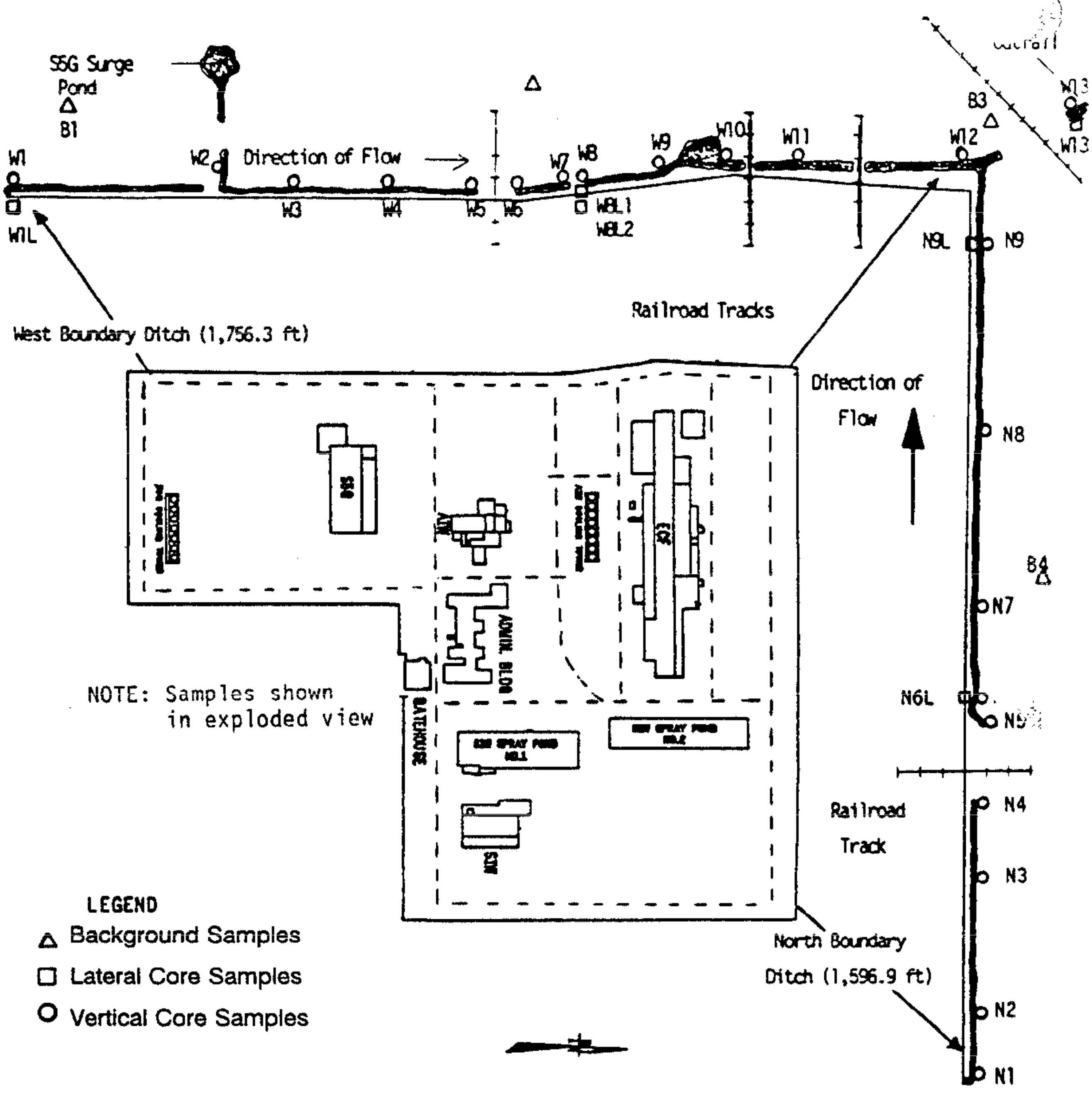


Figure 2-15 1985 Specific Core Locations

Table 2-7 Total Chromium Concentrations 1985

Sample #	Channel Location (ft)	Core Type	Chromium Concentration (ppm)							
			(in.) 3	6	9	12	15	18	21	24
West Channel										
W1	Start (0)	Vertical	*	*	*	*	28	NC	NC	NC
		Vertical	*	*	*	28	41	92	37	NC
		Lateral	*	*	*	*	39	14	10	16
W2	408	Vertical	*	*	*	*	*	*	*	*
W3	578	Vertical	*	*	*	*	*	*	*	*
W4	731	Vertical	*	*	*	*	*	*	*	
W5	884	Vertical	*	96	43	29	26	19	NC	NC
W6	986	Vertical	*	110	91	25	22	24	25	NC
W7	1037	Vertical	*	*	40	54	43	32	23	27
W8	1088	Vertical	*	*	100	280	49	31	27	20
		Lateral	*	17	75	38	47	32	33	NC
		Lateral	*	*	*	*	*	*	44	NC
W9	1207	Vertical	*	*	*	*	*	29	39	41
W10	1343	Vertical	*	*	*	*	*	*	98	72
W11	1462	Vertical	*	*	*	*	100	400	190	67
W12	1751	Vertical	*	*	*	*	200	270	180	530
W13	Outfall	Vertical	*	*	1200	950	36	17	25	NC
		Lateral	*	*	180	140	66	120	72	NC
North Channel										
N1	Start (0)	Vertical	*	*	*	26	38	21	7	11
N2	102	Vertical	*	*	27	11	10	13	5	NC
N3	323	Vertical	*	*	27	20	24	17	18	NC
N4	510	Vertical	*	*	160	26	16	16	17	NC
N5	646	Vertical	*	*	*	40	29	31	NC	35
N6	697	Vertical	*	59	51	19	31	28	80	NC
N7	884	Vertical	*	*	*	*	60	54	18	NC
N8	1122	Vertical	*	*	*	*	58	29	14	10
N9	1445	Vertical	*	*	*	*	*	25	15	NC
		Lateral	*	*	*	*	31	27	17	13
Background										
B1	W of W1	Vertical	35	*	38	*	*	*	21	*
B2	W of W7	Vertical	26	*	27	*	*	*	21	*
B3	Outfall	Vertical	*	*	*	23	22	21	23	26
B4	N of N8	Vertical	*	*	*	22	22	24	24	20

* Not able to collect sample.
NC Sample not Collected (encountered basalt).
ND Not detected.

Table 2-8 Total Silver Concentrations 1985

Sample #	Channel Location (ft)	Core Type	Silver Concentration (ppm) (in.) 3	6	9	12	15	18	21	24
West Channel										
W1	Start (0)	Vertical	*	*	*	*	ND	NC	NC	NC
		Vertical	*	*	*	ND	ND	ND	ND	NC
		Lateral	*	*	*	*	ND	ND	ND	ND
W2	408	Vertical	*	*	*	*	*	*	*	*
W3	578	Vertical	*	*	*	*	*	*	*	*
W4	731	Vertical	*	*	*	*	*	*	*	*
W5	884	Vertical	*	<25	0.8	ND	0.5	ND	NC	NC
W6	986	Vertical	*	<30	3.2	ND	ND	ND	ND	NC
W7	1037	Vertical	*	*	1.2	ND	ND	ND	ND	ND
W8	1088	Vertical	*	*	13	ND	ND	ND	ND	ND
		Lateral	*	ND	3.5	1.7	3.6	ND	ND	NC
		Lateral	*	*	*	*	*	*	0.7	NC
W9	1207	Vertical	*	*	*	*	*	ND	3.8	1.7
W10	1343	Vertical	*	*	*	*	*	*	ND	0.6
W11	1462	Vertical	*	*	*	*	>79	6.5	>31	2.8
W12	1751	Vertical	*	*	*	*	3.5	14	0.5	1.2
W13	Outfall	Vertical	*	*	1.4	1.7	ND	ND	ND	NC
		Lateral	*	*	1.6	1.8	ND	ND	ND	NC
North Channel										
N1	Start (0)	Vertical	*	*	*	0.6	1.0	ND	ND	ND
N2	102	Vertical	*	*	1.1	ND	ND	ND	ND	NC
N3	323	Vertical	*	*	0.8	ND	1.4	ND	ND	NC
N4	510	Vertical	*	*	13	1.4	0.5	ND	ND	NC
N5	646	Vertical	*	*	*	1.7	0.9	1.4	NC	1.4
N6	697	Vertical	*	3.9	2.8	ND	ND	ND	7.3	NC
N7	884	Vertical	*	*	*	*	5.7	1.6	0.7	NC
N8	1122	Vertical	*	*	*	*	4.7	0.9	ND	ND
N9	1445	Vertical	*	*	*	*	*	1.5	ND	NC
		Lateral	*	*	*	*	3.7	1.1	1.0	0.8
Background										
B1	W of W1	Vertical	ND	*	ND	*	*	*	ND	*
B2	W of W7	Vertical	ND	*	ND	*	*	*	ND	*
B3	Outfall	Vertical	*	*	*	ND	ND	ND	ND	ND
B4	N of N8	Vertical	*	*	*	ND	ND	ND	ND	ND

* Not able to collect sample.
NC Sample not Collected (encountered basalt).
ND Not detected.

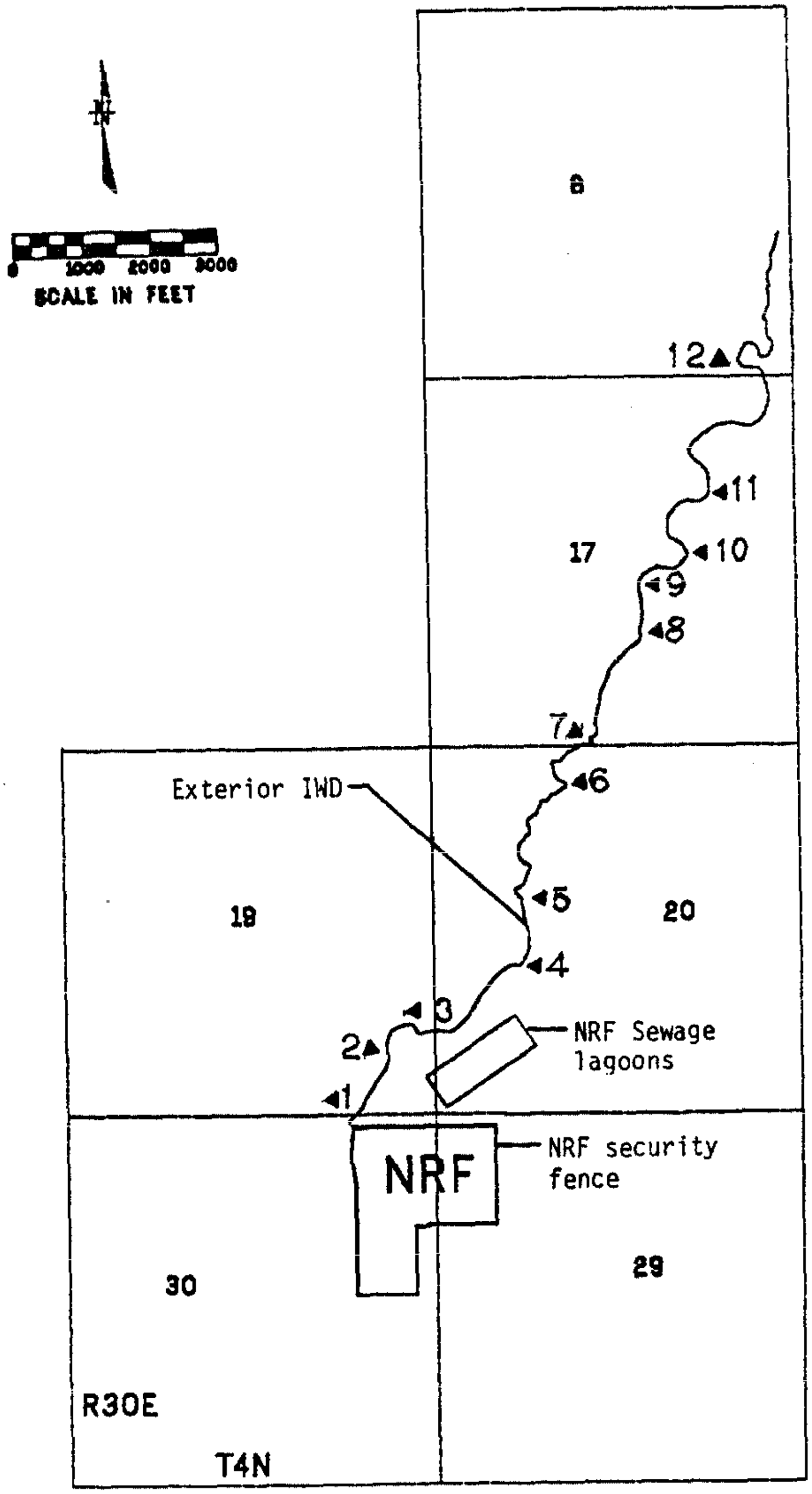


Figure 2-16 Shallow Sediment Sample Locations for Chromium Determination (1986)

Table 2-9 presents chromium data from shallow sediment samples which were collected along the IWD in October 1986 using a coring device. Samples were collected at the outfall and proceeding northeast for approximately 3.2 miles. Results of the data indicate that chromium levels measured as total chromium exceeded 1985 fence upgrade background levels from the outfall to the end of the ditch (3.2 miles). Measured values ranged from 49 ppm total chromium to 1300 ppm total chromium, with an average concentration of 262 ppm total chromium. The presence of chromium in the ditch did not appear to be correlated with visible observations of oily waste, since chromium was present along the entire length of the ditch, while visible evidence of oily waste was only observed along the first 9,000 feet of the ditch. Concentrations of oily waste appeared to decrease along the length of the ditch, while chromium concentrations remained relatively constant throughout the length of the ditch. Average concentrations of chromium in most of the sample locations were similar (200 - 250 ppm total chromium). This project was a limited sampling effort. Adequate quality control information, such as duplicate sample results, matrix spike results, or decontamination procedures is not available to perform a detailed data validation.

The data collected during this effort were presented in the COCA Phase I Closure Plan (prepared by NRF Environmental Controls).

2.5.3 IWD Sediment Core Samples (1986)

Core samples were collected from the IWD in November, 1986 to obtain comprehensive data identifying the universe of contaminants present in the IWD to a depth of 15 inches. In order to reduce costs and meet sampling goals, cores were extracted from the portion of the ditch containing liquid waste. Samples obtained from the area of the channel containing liquid waste best represent the portion of the IWD constantly subjected to water flux and potential waste migration. Ten cores were collected at 0.3 mile intervals along the ditch beginning at the outfall and extending along the channel to a length of approximately 1.8 miles, and from one background location 200 feet southeast of the fifth sampling point. The background sample was collected in an undisturbed area that consisted of dry clay soil similar to the clays found in the IWD. Each core consisted of five three inch segments. Figure 2-17 illustrates core sample locations.

The sampling area was gridded into 0.2 mile sections and individual sampling points were marked with survey stakes. Cores were extracted using a carbon steel coring device fitted with an acrylic tube insert. The device was designed to reduce the risk of cross contamination as well as the ability to survive the impact of sampling sand/gravel alluvium. Following individual core extraction procedures, the collection device was decontaminated and refitted with a new acrylic tube insert.

Table 2-9 Total Chromium Concentration for 1986 Shallow Sediment Samples

EXTERIOR UNCOVERED DITCH

All samples were collected from a depth of zero to six inches.

Sample No.	Distance from Outfall (feet)	(mi)	Total Chromium (ppm)	Method #	MDL
1	00000	0.00 (Outfall - Ditch Begins)	300	*	**
2	01056	0.2	170	*	**
3	02640	0.5	120	*	**
4	04224	0.8	210	*	**
5	05808	1.1	100	*	**
6	07392	1.4	1300	*	**
7	08976	1.7	49	*	**
8	10560	2.0 (Water Ends)	290	*	**
9	12144	2.3	360	*	**
10	13728	2.6	120	*	**
11	15312	2.9	60	*	**
12	16896	3.2 (Ditch Ends)	62	*	**

1986 Data was compared to Background data collected during 1985 fence upgrade loess samples.

1985 chromium Data	
sample size	16
mean	24.68
standard deviation	5.05

* Test methods not located
** MDL not located

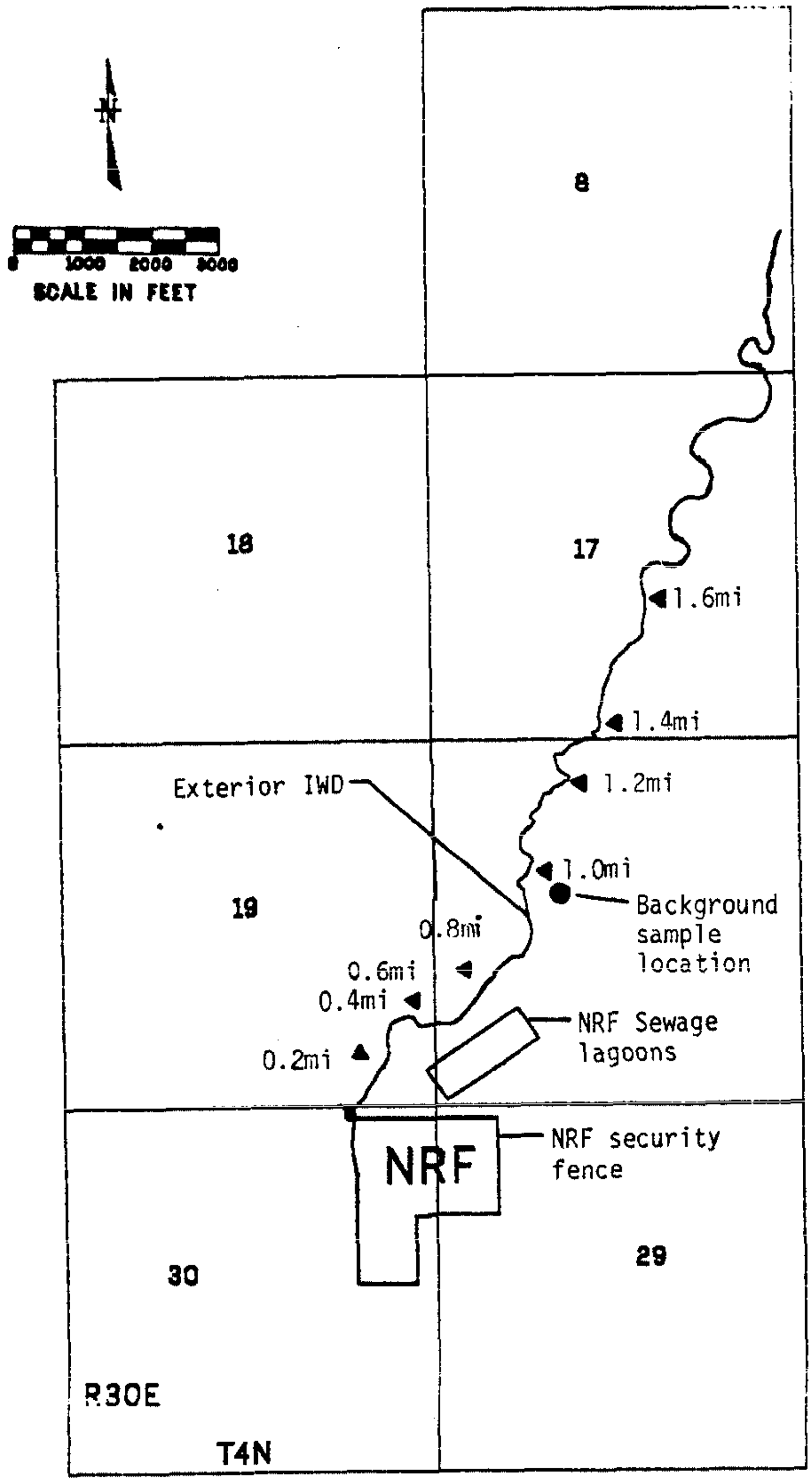


Figure 2-17 IWD Core Sample Locations (1986)

Analyses were conducted at a contracted laboratory. Prior to obtaining a contract for the analyses, laboratory quality control procedures were reviewed, and were found to be acceptable. Samples were analyzed for Volatile Organic Carbons (VOCs) and 13 different heavy metals. Included in the analyses was the differentiation between concentrations of trivalent and hexavalent chromium species. These categories of compounds were selected for analysis since the presence of metals had been identified from previous data, and oily waste was visibly present in the channel. Analyses were conducted following EPA procedures for 'Appendix VIII' constituents excluding Semi-Volatile Organic Carbons (SVOCs) and Extraction Procedure (EP) metal toxicity. A summary of results from the analyses is presented in Table 2-10. Data is presented as the total metal concentration from the ground surface to a depth of three inches (one of five samples from one core). Background data represents the average concentration from four segments collected from a single core.

The data presented in Table 2-10 indicates that seven different heavy metals were encountered in channel sediments along the IWD, including chromium, mercury, lead, copper, zinc, nickel, and silver. Concentrations of most heavy metals were higher in the upper channel surface (from the ground surface to six inches) than in samples collected at depths from within the channel (12 to 15 inches). Table 2-11 identifies the total metal concentrations in channel sediments at a depth of 12 to 15 inches.

The data presented in Table 2-11 indicates a decrease in metal concentrations between the channel surface and a depth of 15 inches at most core locations. However, a limited number of cores depicted increases in metal concentrations from the channel surface to 15 inches. Figure 2-18 identifies changes in total chromium concentrations along the length of the channel and changes with depth through the channel to 15 inches. Figure 2-18 also indicates decreases in chromium concentrations from zero to 15 inches at most core locations. However, chromium concentrations increased with depth in cores collected at 0.8 miles and 1.8 miles. Variations in metal concentrations may be attributed to varying soil types along the length of the channel and with depth. Several core samples could only be collected to nine inches due to the presence of basalt. Other core samples were difficult to obtain due to the presence of coarse alluvium. Several cores were collected in clayey soils. In addition, the surfaces of several cores consisted of a thick layer of algae. Each of these factors is expected to influence the concentrations of metals present in samples.

Table 2-10 Total Heavy Metal Concentrations for 1986 Core Samples

IWD LENGTH		TOTAL METAL CONCENTRATION (ppm) TO 3 INCHES (Data for 1 of 5 samples from a single core)							
Sample Location Feet	Miles	Cr+6	Cr+3	Hg	Cu	Pb	Zn	Ni	Ag
0000	Outfall	5.1	690	11	130	40	190	72	3
1056	0.2	6.7	280	17	150	40	170	110	5
2112	0.4	17.0	350	17	220	50	460	130	4
3168	0.6	12.0	620	48	170	40	160	52	10
4224	0.8	9.2	280	6	170	40	330	63	3
5280	1.0	5.3	170	2	41	16	290	40	1
6336	1.2	1.4	77	2	44	<10	110	30	ND
7392	1.4	2.6	62	0.3	26	12	190	50	2
8448	1.6	17.0	1200	2	99	18	220	30	ND
9504	1.8	1.1	30	ND	14	<10	74	30	1
1986 Core Background									
Background (ppm)		14	45	ND	29	19	149	35	0.07
Standard Deviation		3.8	5.8	NA	2.5	8	52	10.5	0.27
Method Number		*	*	*	*	*	*	*	*
Limit of Detection ppm		0.1	5.0	0.05	1.0	1.0	10	5.0	0.5

Note:
ND - Not Detectable
NA - Not Applicable
* - Test method not located

Table 2-11 Total Heavy Metal Concentrations for 1986 Core Samples (12" - 15")

IWD LENGTH		TOTAL METAL CONCENTRATION (ppm) FROM 12" - 15" (Data for 1 of 5 samples from a single core)							
Sample Location Feet	Miles	Cr+6	Cr+3	Hg	Cu	Pb	Zn	Ni	Ag
0000	(Outfall)	NA	NA	NA	NA	NA	NA	NA	NA
1056	0.2	0.4	50	0.13	17	10	67	10	ND
2112	0.4	1.2	40	0.26	24	10	100	20	ND
3168	0.6	1.0	50	0.08	31	30	200	57	1
4224	0.8	0.8	510	0.04	22	20	58	30	ND
5280	1.0	5.7	40	ND	21	15	140	40	ND
6336	1.2	NA	NA	NA	NA	NA	NA	NA	NA
7392	1.4	1.1	55	0.31	25	11	130	20	ND
8448	1.6	12.0	79	ND	33	17	170	50	ND
9504	1.8	19.0	200	0.23	56	22	420	63	1
1986 Core Background									
Background (ppm)		14	45	ND	29	19	149	35	0.07
Standard Deviation		3.8	5.8	NA	2.5	8	52	10.5	0.22
Method		*	*	*	*	*	*	*	*
Limit of Detection ppm		0.1	5.0	0.05	1.0	1.0	10	5.0	0.5

Note:
ND - Not Detectable
NA - Not Applicable (No sample collected)
* - Test method not located

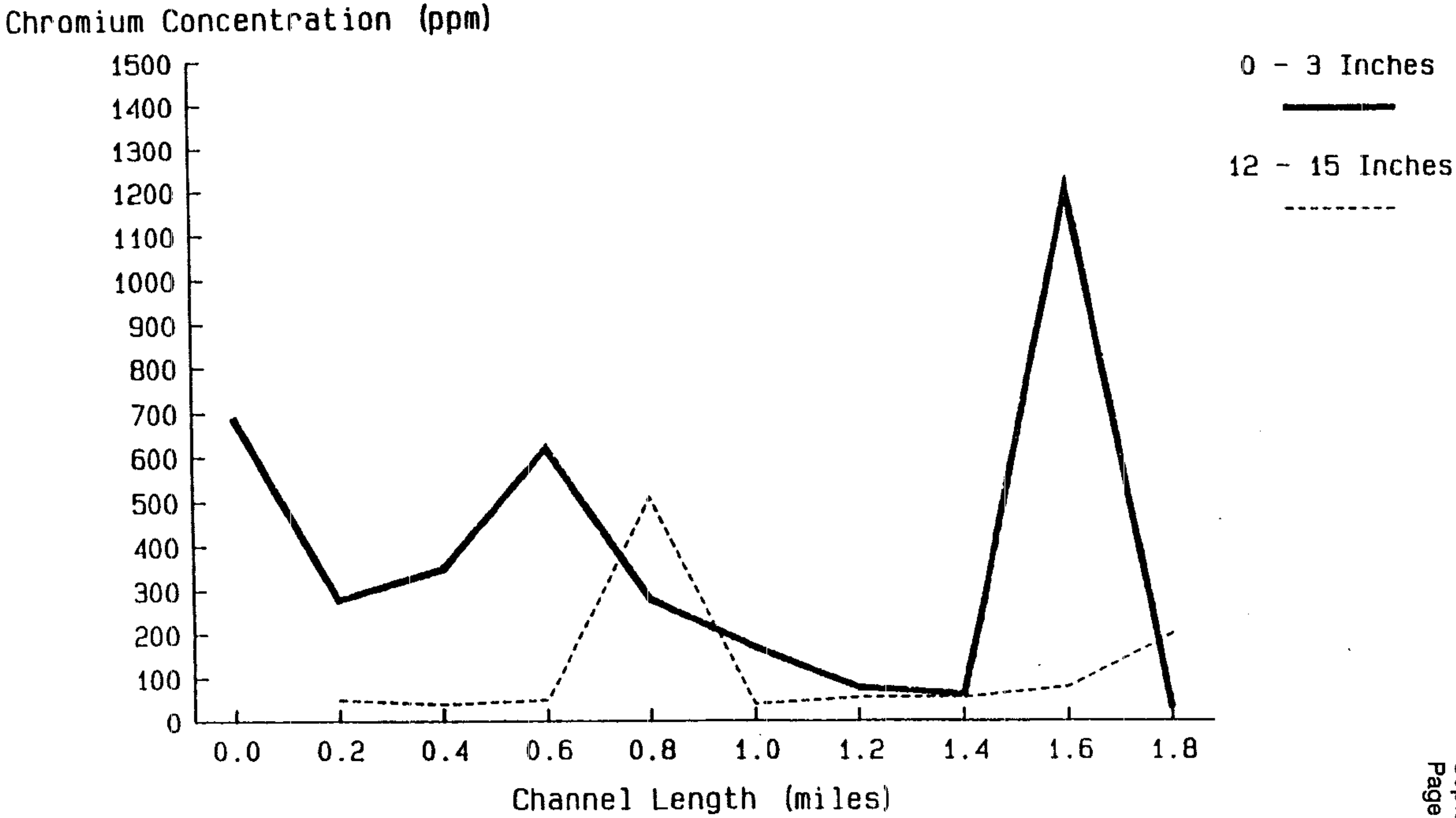


Figure 2-18 Distribution of Chromium Along the IWD to a Depth of 15 Inches

VOCs were not present in core samples collected along the length of the ditch to depths of 15 inches, with the exception of five samples. These five samples contained traces (1.2 to 4.6 ppb) of methvlene chloride, a common laboratory artifact. The lack of data confirming the presence of VOCs was not expected since it is possible to see a thin layer (2-3 inches) of oily residue along the length of the ditch and disturbance of channel sediments produces a black, oily residue in the waste water flowing through the channel.

The data collected during this effort were presented in the COCA Phase I Closure Plan (prepared by NRF Environmental Controls).

2.6 1987/88 Phase I Closure Plan Sample Collection Report

In 1987, NRF contracted with Envirodyne Engineers Inc. to collect detailed samples characterizing the IWD as defined in the Phase I Closure Plan. The tasks involved in completing the investigation consisted of two primary activities; conducting a preliminary shallow soil sampling and analysis program, and conducting a series of both shallow and deep boreholes. The contract included provisions for detailed sampling inside the NRF, background sampling, and sampling of the IWD channel.

Sampling was performed to provide an accurate and comprehensive evaluation of the constituents present in the NRF IWD. The data collected during this investigation is summarized in Sections 2.6.1 through 2.6.3.

2.6.1 Background Sampling

In 1987/88, eighteen soil samples for background data. Samples were collected from surface areas and old stream bed channels associated with the historical flow of the Big Lost River. Dry stream bed samples were considered significant, since the IWD originally had been designed to flow in the course of an old channel. NRF speculated that constant water action may have deposited sediments in the channel beds with higher concentrations of heavy metals than surface soils unaffected by run-off in the Big Lost River. Background samples from these two situations (surface areas and stream beds) were expected to consist of three soil types including loess, sediment from old dry river bed channels, and older alluvium. These three soil types were considered the only soil types present in the IWD which could have been affected by waste disposal operations. The physical deposition of the soils also provided the opportunity to collect data with varied depth. Loess and channel sediments were located on top of the older alluvial soils. Care was taken to ensure that samples collected represented background levels and were not influenced by facility operations. Selected background sample locations are illustrated in Figure 2-19.

Table 2-12 provides the results of background sampling. No organic compounds were detected; the results of analyses for metals alone are presented in the table. Thirteen metals were evaluated, including

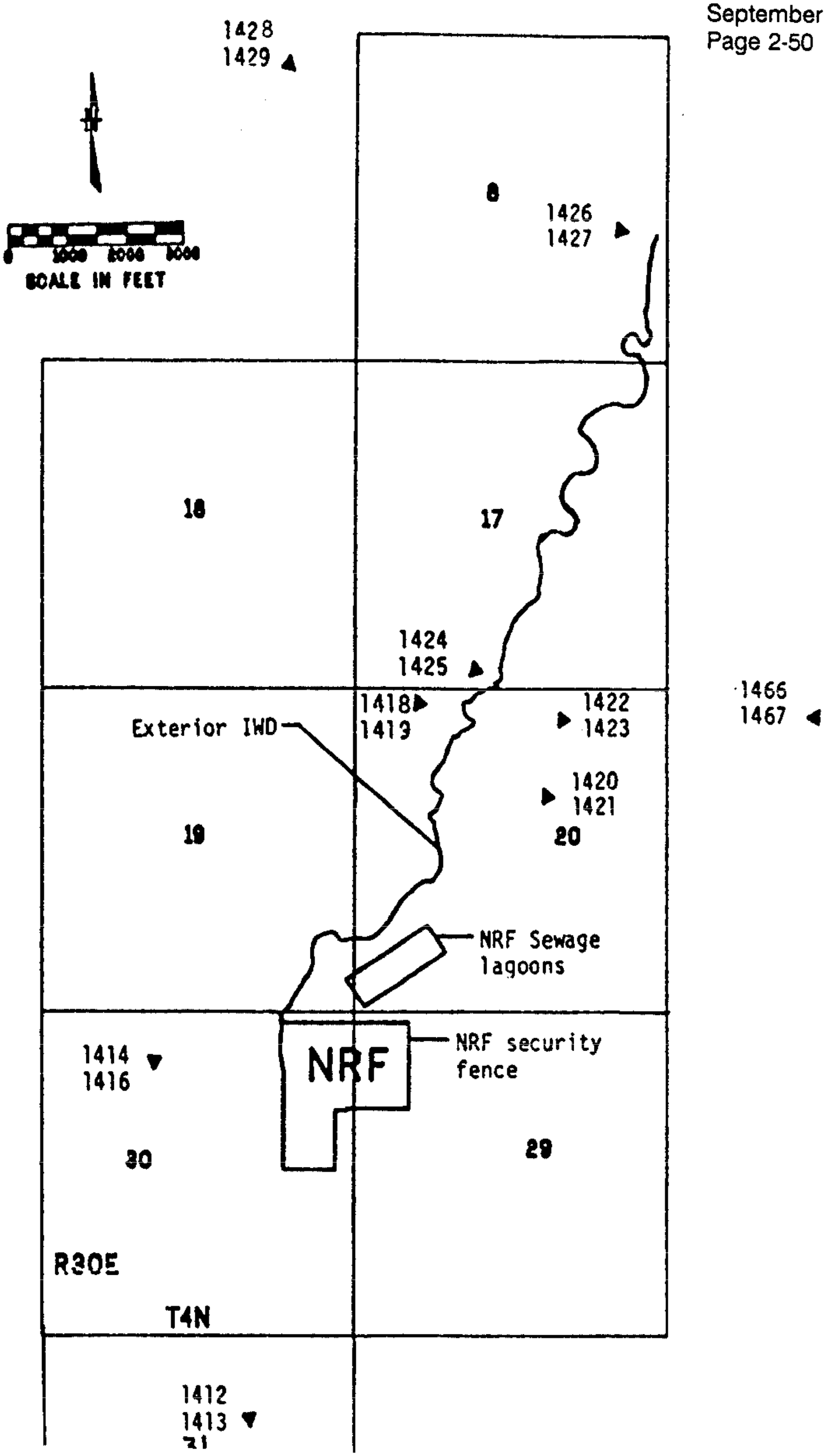


Figure 2-19 1987/88 Background Sample Locations

Table 2-12 Summary of Background Samples Collected

Sample #	Sample Type	Sample Depth	Total Metal Concentration (ppm)						
			As	Cr	Cu	Pb	Ni	Zn	Ag
Surface Soils									
1412	Loess	00"-70"	6.8	30	24	20	32	151	ND
1413	Alvm.	70"-75"	12	27	20	11	31	128	ND
1414	Loess	00"-24"	6.3	23	21	19	33	129	ND
1416	Alvm.	24"-31"	1.8	24	15	9.9	24	86	ND
1428	Loess	00"-45"	5.2	34	26	20	38	162	ND
1429	Loess	45"-76"	9.8	49	37	22	61	254	ND
1466	Loess	00"-34"	7.5	45	32	28	52	247	ND
1467	Alvm.	34"-42"	5.8	21	14	10	25	116	ND
Dry Stream Beds									
1418	Sedm.	00"-06"	7.9	39	32	21	45	191	ND
1419	Loess	10"-14"	7.0	24	24	14	39	146	ND
1420	Sedm.	00"-06"	3.6	32	26	27	33	161	ND
1421	Alvm.	08"-12"	6.0	15	15	12	23	89	ND
1422	Sedm.	00"-04"	5.9	24	23	19	31	151	ND
1423	Loess	08"-12"	3.9	17	12	32	22	60	ND
1424	Sedm.	00"-04"	9.6	108	36	32	46	218	0.8
1425	Alvm.	10"-12"	7.4	34	25	23	40	143	0.5
1426	Sedm.	00"-03"	7.9	35	21	21	32	135	ND
1427	Alvm.	06"-12"	5.6	28	18	4.0	29	119	ND
1428	Loess	00"-44"	5.2	34	26	20	38	162	ND
1429	Loess	44"-76"	9.8	49	37	22	61	254	ND
Statistical Data (all samples)									
# of Samples			20	20	20	20	20	20	20
Mean (x)			6.8	34.6	29.2	19.3	36.7	154.9	0.06
Method			*	*	*	*	*	*	*
MDL			**	**	**	**	**	**	**

NOTE:
Sb, Be, Cd, Hg, Se, and Tl not detected in any samples. ND - Not Detected.
* Test methods not located
** MDLs not located

chromium, mercury, lead, nickel, silver, copper, arsenic, beryllium, cadmium, and selenium. All of the metals were not detected in all samples. Therefore, only those metals with concentrations greater than the detection limit are listed.

2.6.2 COCA Phase I Sediment Sampling

Figure 2-20 identifies the locations of core samples extracted from exterior channel sediments to a depth of 12 inches. These samples were analyzed for comprehensive SVOCs, pesticides/PCBs, and heavy and EP toxicity metals (chromium, lead, silver, mercury). Table 2-13 summarizes Total Metal and EP toxicity concentrations for the core samples.

Table 2-13 indicates the presence of chromium, lead, mercury, and silver greater than background levels in channel sediments to depths of 12". However, none of the collected samples were EP toxic. These sample analyses predated the TCLP analysis; however, based on the nature of the analysis method, none of the samples would have been expected to exceed the TCLP limits.

Table 2-13 provides information indicating the types of organic compounds present in the IWD sediments. Analysis was also conducted for pesticides/PCBs, using USEPA CLP protocols (SOW 787); however, none were detected.

Table 2-13 indicates the presence of various organic compounds in channel sediments. One compound detected in 10 of 12 samples is 2(3H)dihydrofuranone. This compound was identified during a library search as required in the CLP SOW and is associated with "cutting oil" products and may be present due to historical uses. All of the other listed compounds are attributable to laboratory artifacts (methylene chloride), decontamination (acetone), or sampling containers (phthalates). Other analyzed organics which were not detected included herbicides, organo-phosphates, and carbofuran compounds.

The 1987/88 Phase I Closure Plan Sample Collection Report data indicates that the IWD sediments contain various heavy metals in concentrations higher than surface soil background levels, but do not exceed EP Tox levels. These sediments are also not expected to exceed Toxicity Characteristic Leaching Procedure (TCLP) levels. Metals are generally located within the upper several inches of the channel sediments. Organics in the form of oily waste degradation products are also present in the IWD. Chromium is the most prevalent contaminant in the IWD sediments and has been identified over the entire 3.2 mile length. The quality and useability of these data are unknown. All existing data will be evaluated during the RI/FS process and based upon this evaluation, the existing data will be used as appropriate.

2.6.3 COCA Phase I Dredge Pile Sampling

The IWD has been dredged on at least two separate occasions (1973-1975 long dredge and 1980). Dredging was necessary to clear the channel of reeds and other plant growth inhibiting waste water flow. The channel was dredged with a drag-line which scooped sediments from the channel and placed them in piles, approximately 10 to 15 feet wide and two to five feet deep, along the ditch embankment. The entire ditch, from the outfall to 1.65 miles, has been dredged. A total of approximately 13,600 cubic yards of dredge spoils are present along both channel embankments. Figure 2-21 identifies the locations of dredge spoil piles and selected sampling locations. Table 2-14 summarizes the results of samples collected from the piles during November 1987. Samples were collected along each embankment at 0.2 mile intervals.

Each sample consisted of a composite core extracted through the entire depth of the dredge spoil pile. Samples were analyzed for seven selected metals detected in previous sampling, including mercury, chromium, silver, lead, zinc, nickel, and copper. A portion of each core sample was also collected and combined with other core samples to form four Appendix VIII samples. Appendix VIII analysis refers to Appendix VIII of 40 CFR 261, which contains a list of chemicals that have been shown to have toxic, carcinogenic, mutagenic, or teratogenic effects on humans. The Appendix VIII list is utilized for determination of a universe of constituents that may be present, and is used to screen soils and ground water potentially contaminated with unknown chemical constituents. The Appendix VIII analysis includes tests for VOCs, SVOCs, Sulfide, Cyanide, Total Organic Halides (TOX), Total Organic Carbon (TOC), and 26 metals. Each Appendix VIII sample represents one-half the length of the ditch along both sides of the channel. From this perspective, each block of data presented in Table 2-16 is also represented by an Appendix VIII sample. Appendix VIII samples were collected to ensure that adequate characterization of wastes was performed. Dredge spoil piles were selected for sampling since wastes in the piles represented channel sediments potentially contaminated from the onset of operations at the NRF. The results of Appendix VIII analyses are presented in Table 2-16 (inorganics) and Table 2-17 (organics).

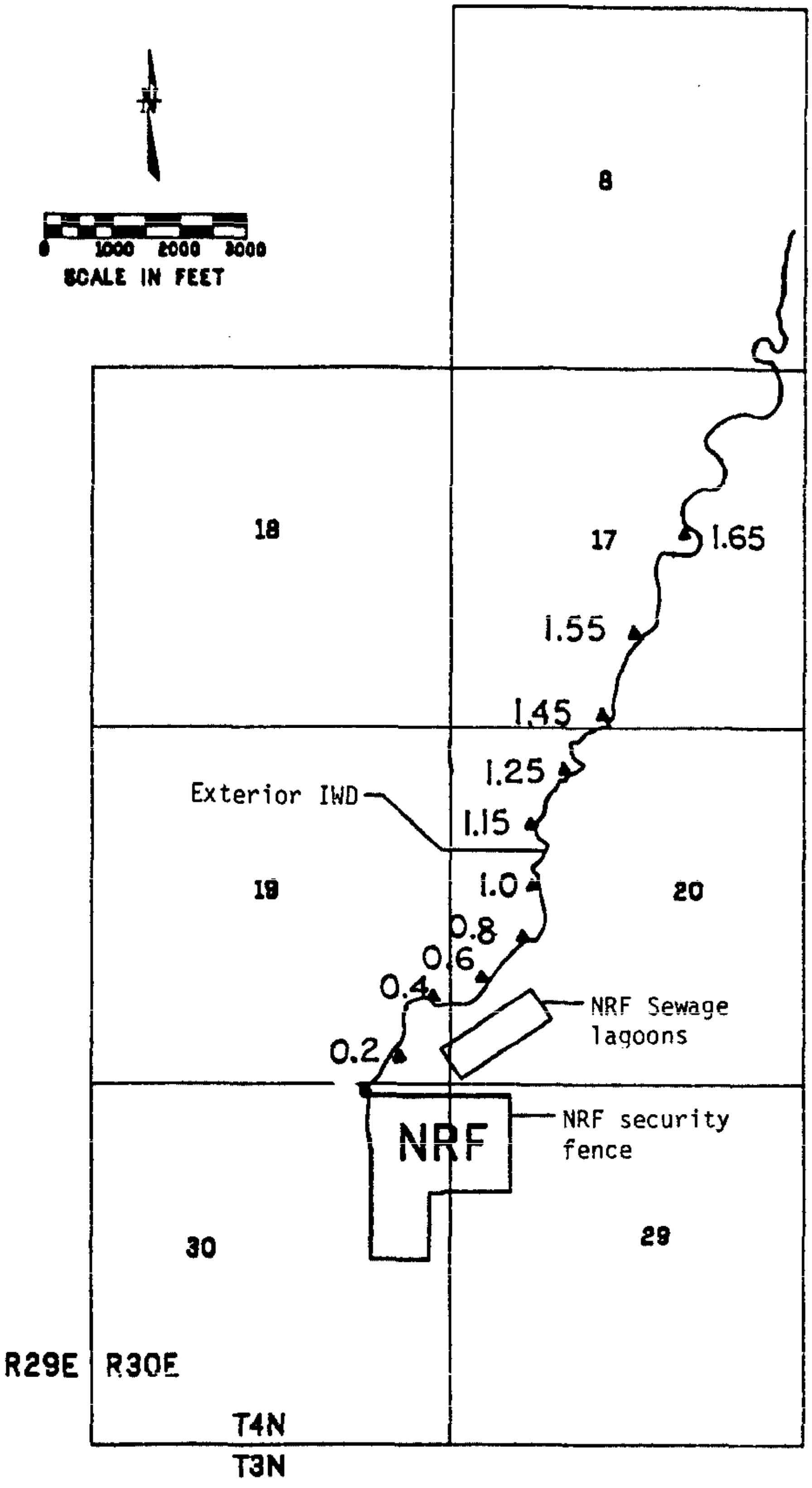


Figure 2-20 Locations of Core Samples Collected From the IWD Channel at Depths 00-12 inches

Table 2-13 Summary of Total Metal and EP Toxicity Concentrations for COCA Phase I Sediment Sampling

SAMPLE DATA CONCENTRATION OF HEAVY METALS IN SOILS 00 TO 12 INCHES (ppm)
Sample Depth Zero to Twelve Inches

Sample #	Sample Type	Sample Location (mi.)	Total Metal				EP-Toxicity			
			Cr	Pb	Hg	Ag	Cr	Pb	Hg	Ag
1409	Sedm.	Outfall	321	35	24	5	ND	ND	ND	ND
1408	Sedm.	0.20	179	29	1.6	1.6	ND	ND	ND	ND
1411	Sedm.	0.20	178	20	2.6	1.3	ND	ND	ND	ND
1407	Sedm.	0.40	197	16	0.9	0.8	ND	ND	ND	ND
1406	Sedm.	0.60	714	31	0.5	2.9	ND	ND	ND	ND
1405	Sedm.	0.80	200	24	0.6	1.8	ND	ND	ND	ND
1404	Sedm.	1.00	268	26	3.4	2.6	ND	ND	ND	ND
1410	Sedm.	1.00	207	26	1.1	1.9	ND	ND	ND	ND
1403	Sedm.	1.15	424	42	1.4	4.9	ND	ND	ND	ND
1402	Sedm.	1.35	474	23	3.4	2.3	ND	ND	ND	ND
1401	Sedm.	1.55	204	22	0.8	1.3	ND	ND	ND	ND
1400	Sedm.	1.75	380	22	0.7	2.3	0.01	ND	ND	ND
ND - Not Detectable										
Method			*	*	*	*	*	*	*	*
MDL			**	**	**	**	**	**	**	**

Note:
* Test methods not located
** MDL not located

Table 2-14 Summary of Organic Compounds Detected in COCA Phase I Sediment Sampling

SAMPLE DATA			CONCENTRATION (ppm) OF ORGANICS IN SOILS 00 TO 12 INCHES Sample Depth Zero to Twelve Inches	
Sample No.	Sample Type	Sample Location (mi.)	Constituent	Concentration (ppm)
1409	Sedm.	Outfall	bis(2-ethylhexyl)phthalate	5.61
			2(3H)dihydrofuranone	190
			unknown BNA organics (19)	191*
1408	Sedm.	0.20	unknown BNA organics (20)	26*
1411	Sedm.	0.20	bis(2-ethylhexyl)phthalate	40.7
			di-n-octylphthalate	4.3
			2(3H)dihydrofuranone	190
			dioctylester hexanedioic acid	170
			unknown BNA organics (18)	16*
1407	Sedm.	0.402	(3H)dihydrofuranone	63
			unknown BNA organics (1)	0.01*
1406	Sedm.	0.60	2(3H)dihydrofuranone	190
			2-methylpentane	26
1405	Sedm.	0.80	2(3H)dihydrofuranone	240
1404	Sedm.	1.00	2(3H)dihydrofuranone	170
1410	Sedm.	1.00	unknown BNA organics (20)	0.01*
1403	Sedm.	1.15	2(3H)dihydrofuranone	200
1402	Sedm.	1.35	2(3H)dihydrofuranone	90
1401	Sedm.	1.552	(3H)dihydrofuranone	140
1400	Sedm.	1.75	4-methyl,4-hydroxy,2-pentanon	71
			3-methyloctane	1.9
			1,1,2,2-tetrachloroethane	4.5
			tetrahydro,2-furanmethanol	1.6
			unknown BNA organics (16)	15*

* Total concentration of all unknown organics

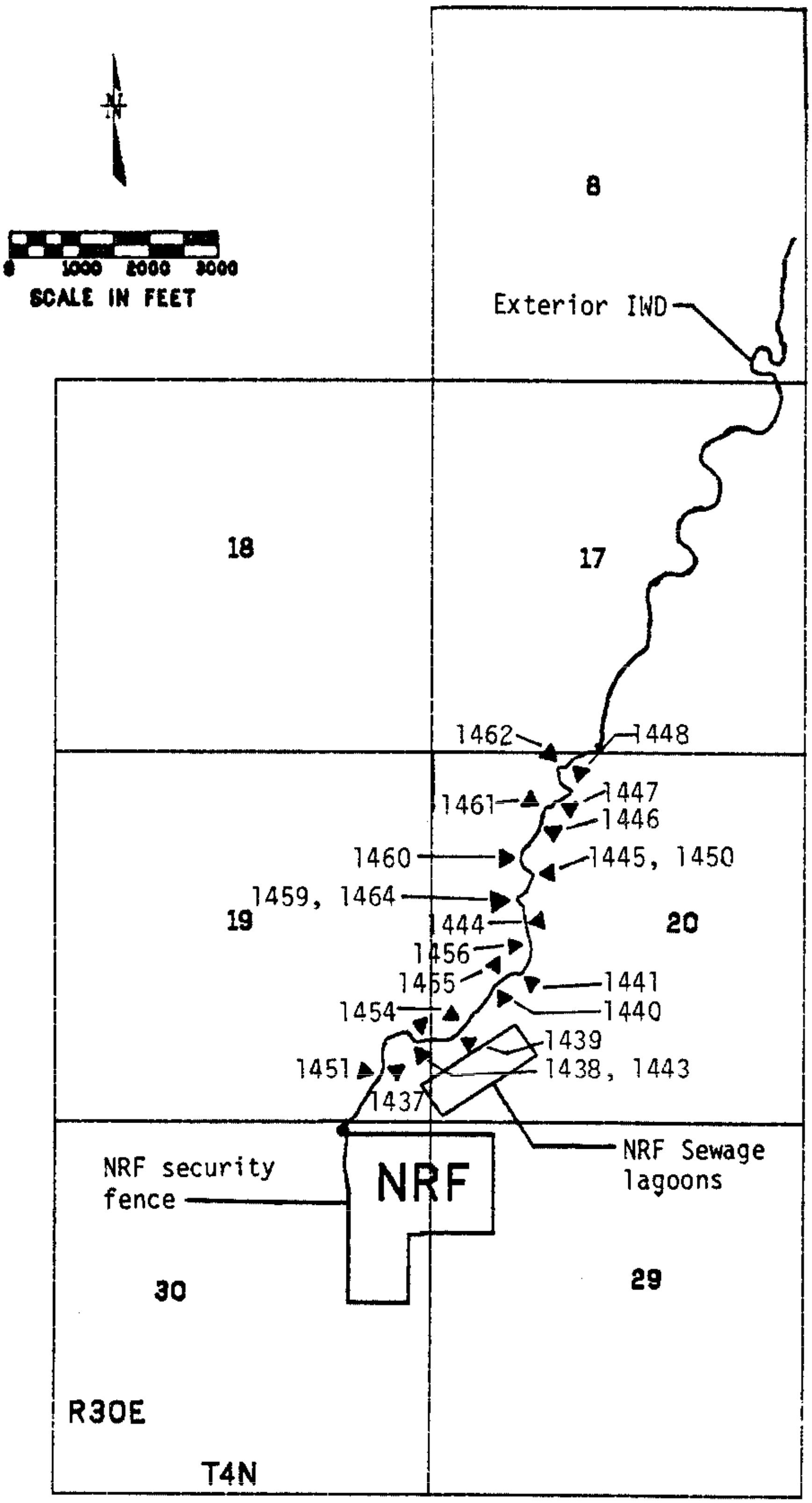


Figure 2-21 Dredge Pile Locations

Table 2-16 indicates the presence of chromium and mercury from dredge spoils in concentrations greater than background. Other metals were either undetected, or were detected in concentrations similar to background values. Table 2-17 identifies those organics found in concentrations greater than the detection limit. All of the listed compounds are possibly attributable to laboratory artifacts (methylene chloride), decontamination (acetone), or sampling containers (phthalates). None of the concentrations were at levels of concern. Other analyzed organics which were not detected included PCBs, pesticides, herbicides, organo-phosphates, and carbofuran compounds.

2.7 Phase II Activities

The Phase II closure plan summarized the results of the Phase I sampling activities and outlined the next phase of sampling. Due to the transition from the COCA to the FFA/CO, the only portions that were implemented were the ground water monitoring and well drilling program and the plant and algae study. The drilling program included the recovery of two 500 foot continuous cores and the completion of two aquifer monitoring wells and seven shallow perched water wells. A total of 15 shallow borings were drilled, seven were converted into monitoring wells and eight were abandoned. Physical property determinations and chemical analysis have been performed on the core samples, and ground water samples have been collected and analyzed. Figure 2-11 shows the wells used in the NRF ground water monitoring program, including the wells drilled in 1991.

2.7.1 Ground Water Monitoring

The NRF water supply has been monitored for several years. The United States Geological Survey (USGS) has monitored ground water for physical parameters (conductivity and pH), radioactivity, chromium, sodium, and chloride from 1980 to the present. The quality of water in all samples was within the Idaho State regulatory limits; there were no out-of-specification values noted. NRF has monitored the domestic water system in accordance with Title 1 Chapter 8, Idaho Regulations for Public Drinking Water Systems, from 1987 through the present. Other data has been collected by subcontractor personnel. NRF has published the results of analysis of selected parameters in the annual Naval Reactors Facility Environmental Monitoring Report. Portions from the 1990 and 1991 reports which summarize the results of sampling for those parameters of specific concern are provided as Tables 2-18 and 2-19.

It is noted that the some of the analysis results from the 1991 sampling of wells NRF 6 and 7 exceed those from other locations. The cause of this variance is not known, and will be pursued as part of the RI/FS.

Table 2-15 Total Metal Results of COCA Phase I Dredge Pile Sampling

Sample #	Sample Location (mi.)	Embankment	Total Metal Concentration (ppm)						
			Ag	Zn	Cr	Hg	Ni	Pb	Cu
Method			*	*	*	*	*	*	*
MDL			**	**	**	**	**	**	**
Front (Appendix VIII sample - 1456)									
1451	0.05	West	ND	109	23	ND	30	12	20
1452	0.25	West	ND	120	25	ND	26	13	17
1457	0.25	West	ND	100	17	ND	25	18	15
1453	0.35	West	ND	431	388	14	49	12	47
1454	0.55	West	ND	101	27	ND	28	14	17
1455	0.70	West	ND	148	45	ND	31	14	20
Back (Appendix VIII sample - 1463)									
1458	0.85	West	ND	102	27	ND	26	13	16
1459	0.95	West	ND	317	27	22	35	15	34
1464	0.95	West	ND	281	243	2.1	28	12	33
1460	1.10	West	ND	200	48	ND	30	22	32
1461	1.25	West	ND	139	60	0.1	19	11	27
1462	1.50	West	ND	141	38	ND	30	14	22
Front (Appendix VIII sample - 1442)									
1437	0.10	East	ND	132	84	0.9	14	ND	43
1438	0.30	East	ND	296	150	ND	25	ND	40
1443	0.30	East	ND	97	20	ND	24	ND	17
1439	0.45	East	ND	94	72	1.1	20	ND	38
1440	0.60	East	ND	539	415	0.3	30	ND	29
1441	0.75	East	ND	287	323	0.8	26	ND	34
Back (Appendix VIII sample - 1449)									
1444	0.85	East	ND	198	352	13	34	ND	45
1445	1.05	East	ND	132	58	ND	27	ND	22
1450	1.05	East	ND	160	77	0.3	37	20	24
1446	1.20	East	ND	109	30	0.5	30	ND	18
1447	1.30	East	ND	696	541	0.4	43	27	37
1448	1.50	East	ND	196	167	ND	27	17	23

ND - Not Detectable
* Test methods not located
** MDL not located

Table 2-16 Appendix VIII Inorganic Results of COCA Phase I Dredge Pile Sampling

CONSTITUENTS	CONCENTRATION OF METALS (ppm)				
Metals	Sample #: Sample Type: Location: Estimated Background	1456 Cmps. W. Front	1463 Cmps. W. Back	1442 Cmps. E. Front	1449 Cmps. E. Back
Aluminum	15,000	9310	10900	8800	10500
Antimony	ND	ND	ND	ND	ND
Arsenic	6.7	5.3	9.4	7.2	11
Barium	244	240	224	257	283
Beryllium	NA	ND	ND	ND	ND
Cadmium	NA	ND	ND	ND	ND
Calcium	5920	25700	20000	1010	13200
Chromium	34	106	3.6	130	281
Cobalt	NA	7.4	10	5	10
Copper	29	24	24	34	35
Iron	17100	16200	18200	16300	17400
Lead	19	15	20	13	17
Magnesium	6310	8720	8480	6030	7670
Manganese	401	218	313	261	283
Mercury	NA	0.2	0.1	0.7	0.5
Molybdenum	NA	ND	ND	ND	ND
Nickel	35	34	35	33	37
Potassium	3700	1950	2160	1480	2040
Selenium	NA	ND	ND	ND	ND
Silver	0.07	ND	ND	ND	ND
Sodium	152	283	694	343	458
Strontium	43	59	ND	38	39
Thallium	NA	ND	ND	ND	ND
Tin	NA	ND	ND	ND	ND
Vanadium	41	31	31	38	33
Zinc	149	262	185	236	327

NOTE: All data presented in this table were obtained from the Phase II Closure Plan.

ND = Not Detected
NA = Data not available

Table 2-17 Appendix VIII Organic Results from Dredge Pile Sampling

Sample No.	Organic Constituent	Concentration (ppm)
1456 (west - front)	Methylene Chloride	0.030
	Acetone	0.059
	Di-n-butylphthalate	0.442
1463 (west - back)	Methylene Chloride	0.030
	Acetone	0.030
	Toluene	0.001
	Di-n-butylphthalate	0.165
1442 (east - front)	Methylene Chloride	0.034
	Acetone	0.062
	bis(2-ethylhexyl)phthalate	0.467
1449 (east - back)	Methylene Chloride	0.042
	Acetone	0.059
	bis(2-ethylhexyl)phthalate	2.53

2.7.2 Plant and Algae Sampling

A two year plant and algae study has been completed at the IWD. Four plants (cattails, reeds, thistles, and algae) were sampled quarterly. Background samples were collected at Mud Lake. Although the data summary report has not been completed at this time, the data appears to show substantial metal uptake in the algae in the IWD. The completed report will be included in the RI/FS report.

2.8 1991 Hydrogeologic Investigation

The Hydrogeologic Investigation was performed by Chen-Northern, Inc. The objectives of the investigation were to collect additional information on subsurface lithologies, aquifer characteristics, ground water occurrence, and water quality in an area down gradient of the IWD. The data collected during this project has not been completely evaluated and validated. A summary report has been issued. Summaries of the work completed and data collected are presented; evaluations and interpretations of the data will be presented in the final RI/FS report.

Table 2-18 Comparison of Results of Analysis of Selected Ions and Nutrients in NRF Ground Water - 1990

PARAMETER	UNITS	STANDARD/ GUIDELINE	UP GRADIENT (USGS WELLS 12,15&17)		ON SITE (NRF WELLS 1,2,3&4)		DOWN GRADIENT (USGS 97,98,99,102, INEL-1)	
			RANGE	MEAN	RANGE	MEAN	RANGE	MEAN
AMMONIA PLUS ORGANIC N (AS N)	mg/l	(g)	<0.2 TO 0.5	<0.3(a)	<0.2 TO 0.5	<0.3(a)	<0.2 TO 1.2	<0.3(a)
BROMIDE	mg/l	(g)	<0.01 TO 0.08	<0.02(a)	0.05 TO 0.08	0.07±0.01	0.03 TO 0.35	0.11±0.11
CHLORIDE	mg/l	250(f)	4.8 TO 35	18±13	30 TO 50	38±6	13 TO 140	43±38
CHROMIUM	mg/l	0.05(e)	0.002 TO 0.008(b)	0.006±0.003	0.002 TO 0.014	0.01±.002	0.004 TO 0.019	0.008±0.003
FLUORIDE	mg/l	4.0(e)	<0.1 TO 0.6	<0.2(a)	<0.1 TO 0.6	<0.2(a)	<0.1 TO 0.5	<0.2(a)
IRON	mg/l	0.3(f)	<0.01 TO 0.34(b)	<0.082(a)	<0.010 TO 0.15(c)	<0.055(a)	<0.01 TO 1.9	<0.274(a)
LEAD	mg/l	0.05(e)	<0.001 TO 0.002	<0.001(a)	<0.001 TO 0.003	<0.001(a)	<0.001 TO 0.008	<0.003(a)
MERCURY	mg/l	0.002(e)	<0.0001 TO 0.0001	<0.0001(a)	<0.0001	<0.0001(a)	<0.0001	<0.0001(a)
NICKEL	mg/l	(g)	<0.001 TO 0.003(b)	<0.001(a)	<0.001 TO 0.003	<0.002(a)	<0.001 TO 0.008	<0.002(a)
NITRITE (AS N)	mg/l	(g)	<0.01 TO 0.02	<0.01(a)	<0.01	<0.01(a)	<0.01	<0.01(a)
NITRITE PLUS NITRATE (AS N)	mg/l	10(d)(e)	0.3 TO 1.8	1.0±0.7	1.5 TO 2.1	1.7±0.2	0.3 TO 5.9	2.4±1.7

PARAMETER	UNITS	STANDARD/ GUIDELINE	UP GRADIENT (USGS WELLS 12,15&17)		ON SITE (NRF WELLS 1,2,3&4)		DOWN GRADIENT (USGS 97,98,99,102, INEL-1)	
			RANGE	MEAN	RANGE	MEAN	RANGE	MEAN
ORGANIC CARBON, TOTAL	mg/l	(g)	<0.1 TO 0.7(b)	<0.2(a)	0.2 TO 0.7	0.4±0.1	0.1 TO 1.0	0.4±0.2
ORTHOPHOSPHATE (AS P)	mg/l	(g)	<0.01 TO 0.02	<0.01(a)	<0.01 TO 0.02	<0.02(a)	<0.01 TO 0.02	<0.01(a)
pH	pH Units	6.5-8.5(f)	7.3 TO 8.2	7.9±0.2	7.6 TO 8.2	7.9±0.2	7.4 TO 8.2	7.9±0.1
SILVER	mg/l	0.05(e)	<0.001	<0.001(a)	<0.001	<0.001(a)	<0.001	<0.001(a)
SODIUM	mg/l	20(h)	5.6 TO 18	10±4	11 TO 20	15±2	7.9 TO 20	13±3
SPECIFIC CONDUCTANCE	μmho/cm	(g)	291 TO 600	425±130	540 TO 685	587±41	392 TO 800	568±124
SULFATE	mg/l	250(f)	15 TO 35	25±7	34 TO 52	40±5	19 TO 160	40±27

(a) Mean values preceded by < contain at least one less than minimum detection level value in the analysis results.
(b) The following parameter values are anomalously high for USGS Well 15 in the 8/6/90 sample: Chromium - 21 μg/l; Iron - 4600 μg/l; Manganese - 100 μg/l; Nickel - 15 μg/l; Organic Carbon, Total - 1.5 μg/l; Turbidity - 22 NTU. These values are not included in the MAX and MEAN values for the up gradient wells.
(c) Anomalously high value of 1400 μg/l reported for NRF Well 4 in the 6/19/90 sample. This value is not included in the MAX or MEAN values for the on-site wells.
(d) The limit is for Nitrate (As N) only. Since nitrite values are near or below MDL, these quantities represent Nitrate (As N).
(e) Maximum contaminant levels per Title 1, Chapter 8, Idaho Regulations for Public Drinking Water Systems.
(f) Secondary maximum contaminant levels per Title 1, Chapter 8, Idaho Regulations for Public Drinking Water Systems are provided for comparison.
(g) No standard or guideline available.
(h) No maximum per Title 1, Chapter 8, Idaho Regulations for Public Drinking Water Systems. 20 mg/l is suggested as optimum.

Table 2-19 Comparison of Results of Analysis of Selected Ions and Nutrients in NRF Ground Water - 1991

PARAMETER	UNITS	STANDARD/ GUIDELINE	UP GRADIENT (USGS WELLS 12,15&17)		SYSTEM MONITORING (NRF WELLS 6&7)		ON SITE (NRF WELLS 1,2,3&4)		DOWN GRADIENT (USGS 97,98,99,102, INEL-1)	
			RANGE	MEAN (a)	RANGE	MEAN (a)	RANGE	MEAN (a)	RANGE	MEAN (a)
AMMONIA PLUS ORGANIC NITROGEN (AS N)	mg/l	(c)	< 0.20 to 0.20	< 0.20	(g)	(g)	< 0.20 to 0.60	< 0.32	< 0.20 to 0.50	< 0.28
BROMIDE	mg/l	(c)	0.02 to 0.08	0.05 ± 0.02	0.02 to 0.09	0.05 ± 0.04	0.06 to 0.08	0.07 ± 0.01	0.04 to 0.33	0.11 ± 0.11
CHLORIDE	mg/l	250(b)	7.1 to 36	16 ± 11	6.1 to 220	110 ± 120	3.1 to 54	41 ± 7.2	14 to 110	41 ± 33
CHROMIUM	mg/l	0.05 (e)	< 0.001 to 0.008	< 0.004	0.008 to 0.036	0.021 ± 0.014	0.006 to 0.014	0.010 ± 0.002	0.005 to 0.02	0.008 ± 0.003
FLUORIDE	mg/l	4.0(e)	0.1 to 0.3	0.2 ± 0.1	0.2 to 0.3	0.2 ± 0.1	0.1 to 0.2	0.2 ± 0.0	< 0.1 to 0.2	< 0.2 ± 0.0
IRON	mg/l	0.3(b)	< 0.01 to 0.27	< 0.11	0.12 to 0.67	0.33 ± 0.24	< 0.01 to 0.47	< 0.13	0.03 to 2.1	0.29 ± 0.49
LEAD	mg/l	0.05(e)	< 0.001 to 0.002	< 0.001	< 0.001	< 0.001	< 0.001 to 0.004	< 0.002	< 0.001 to 0.006	< 0.002
MERCURY	mg/l	.002(e)	< 0.0001 to 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001 to 0.0001	< 0.0001	< 0.0001	< 0.0001
NICKEL	mg/l	(c)	< 0.001 to 0.002	< 0.001	0.005 to 0.021	0.011 ± 0.007	< 0.001 to 0.006	< 0.002	< 0.001 to 0.003	< 0.002

Table 2-19 Comparison of Results of Analysis of Selected Ions and Nutrients in NRF Ground Water - 1991 (Cont'd).

PARAMETER	UNITS	STANDARD/ GUIDELINE	UP GRADIENT (USGS WELLS 12,15&17)		SYSTEM MONITORING (NRF WELLS 6&7)		ON SITE (NRF WELLS 1,2,3&4)		DOWN GRADIENT (USGS 97,98,99,102, INEL-1)	
			RANGE	MEAN (a)	RANGE	MEAN (a)	RANGE	MEAN (a)	RANGE	MEAN (a)
NITRITE AS NITROGEN	mg/l	(c)	< 0.01 to 0.02	< 0.01	< 0.01	< 0.01	< 0.01 to < 0.01	< 0.01	< 0.01 to < 0.02	< 0.01
NITRITE PLUS NITRATE (AS N)	mg/l	10(e)(f)	0.31 to 1.8	0.93 ± 0.67	0.38 to 1.6	0.94 ± 0.65	1.6 to 2.0	1.8 ± 0.11	1.10 to 5.20	2.33 ± 1.52
NITROGEN, AMMONIA DISSOLVED	mg/l	(c)	< 0.01 to 1.0	< 0.01	< 0.01 to 0.02	< 0.01	< 0.01 to 0.01	<0.01	< 0.01 to 0.50	< 0.21
ORGANIC CARBON	mg/l	(c)	0.1 to 0.5	0.3 ± 0.1	0.4 to 1.2	0.9 ±0.3	0.3 to 1.8	0.6 ± 0.4	0.1 to 0.9	0.4 ± 0.2
ORTHOPHOSPHATE (AS P)	mg/l	(c)	< 0.01 to 0.03	< 0.01	0.01 to 0.06	0.03 ± 0.02	< 0.01 to 0.03	< 0.02	< 0.01 to 0.02	< 0.01
pH	pH Units	6.5-8.5(b)	7.8 to 8.3	8.0 ± 0.2	7.9 to 8.5	8.2 ± 0.4	7.9 to 8.2	8.0 ± 0.1	7.9 to 8.1	8.0 ± 0.0
SILVER	mg/l	0.05(e)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001 to < 0.001	< 0.001	< 0.001	< 0.001
SODIUM	mg/l	20(d)	5.6 to 17.0	9.7 ± 4.1	8.9 to 90	49 ± 46	9.3 to 20	14 ± 3.3	7.8 to 19	12 ± 3.1
SPECIFIC CONDUCTANCE	µmho/cm	(c)	286 to 590	412 ± 131	242 to 1380	809 ± 648	558 to 645	592 ± 28	395 to 798	563 ± 120

Table 2-19 Comparison of Results of Analysis of Selected Ions and Nutrients in NRF Ground Water - 1991 (Cont'd)

PARAMETER	UNITS	STANDARD/ GUIDELINE	UP GRADIENT (USGS WELLS 12,15&17)		SYSTEM MONITORING (NRF WELLS 6&7)		ON SITE (NRF WELLS 1,2,3&4)		DOWN GRADIENT (USGS 97,98,99,102, INEL-1)	
SULFATE	mg/l	250(b)	12 to 36	23 ± 7	14 to 240	130 ± 130	36 to 55	43 ± 6	11 to 61	33 ± 13
TEMPERATURE	°C	(c)	11.5 to 14.0	12.7 ± 0.9	12.0 to 15.5	13.6 ± 1.9	11.5 to 13.0	12.4 ± 0.5	11.5 to 12.5	12.0 ± 0.3

(a) Mean values preceded by < contain at least one less than minimum detection level value in the analysis results.
(b) Secondary maximum contaminant levels per Title 1, Chapter 8, Idaho Regulations for Public Drinking Water Systems are provided for comparison.
(c) No standard or guideline available.
(d) No maximum per Title 1, Chapter 8, Idaho Regulations for Public Drinking Water Systems. 20 mg/l is suggested as optimum.
(e) Maximum contaminant levels per Title 1, Chapter 8, Idaho Regulations for Public Drinking Water Systems.
(f) The limit is for Nitrate (as N) only. Since nitrite values are near or below minimum detection level (MDL), these quantities represent Nitrate (as N).
(g) Ammonia plus organic nitrogen (as N) was not performed for NRF wells 6 and 7.

The tasks completed during the hydrogeologic investigation consisted of the following:

- Drilling two core borings to a total depth of 500 feet
- Installing two aquifer monitoring wells and performing aquifer tests in each well
- Installing one aquifer piezometer well
- Drilling fifteen piezometer borings and installing seven piezometer wells
- Performing organic and inorganic analyses on basalt and sediment cutting samples
- Performing organic and inorganic analyses on ground water samples
- Performing mineral identification analyses and other physical parameter testing on core samples
- Performing hydraulic conductivity tests on core samples
- Collecting geophysical logs in bore holes.

2.8.1 Core Borings

Figure 2-22 shows locations of the bore holes and wells drilled as a result of this investigation. NRF-6P and NRF-7P were bored to approximately 500 feet. NRF-7P was abandoned by filling with a mixture of cement and bentonite grout. The NRF-6P hole was completed as a piezometer well using one inch schedule 80 PVC with 5 feet of .010 factory slot screen installed from 484 to 489 feet. The cross section was constructed from the borings of the holes drilled as part of this investigation together with previously completed borings.

2.8.2 Monitoring Wells

The two monitoring wells were installed as recommended by the 1987/88 Phase I Closure Plan Sample Collection report to support the Phase II Ground Water Monitoring Plan. The location of these wells was established based on existing data with input and concurrence from IDHW and EPA. These wells were completed to a depth of approximately 417 feet, which is approximately 50 feet below the top of the Snake River Plain Aquifer.

Locations of wells NRF-6 and NRF-7 are shown in Figure 2-22. Figures 2-22 and 2-23 show the well completion construction information for NRF-6 and NRF-7. Well NRF-6 was completed to a depth of 417 feet. One perched water zone was encountered during the drilling of this well at about 85 feet below the surface. Another possible perched water zone was encountered at about 115 feet. The hole was grouted to seal off the perched water and then completed to the final depth of 417 feet. NRF-7 was drilled and completed to a depth of 417 feet and

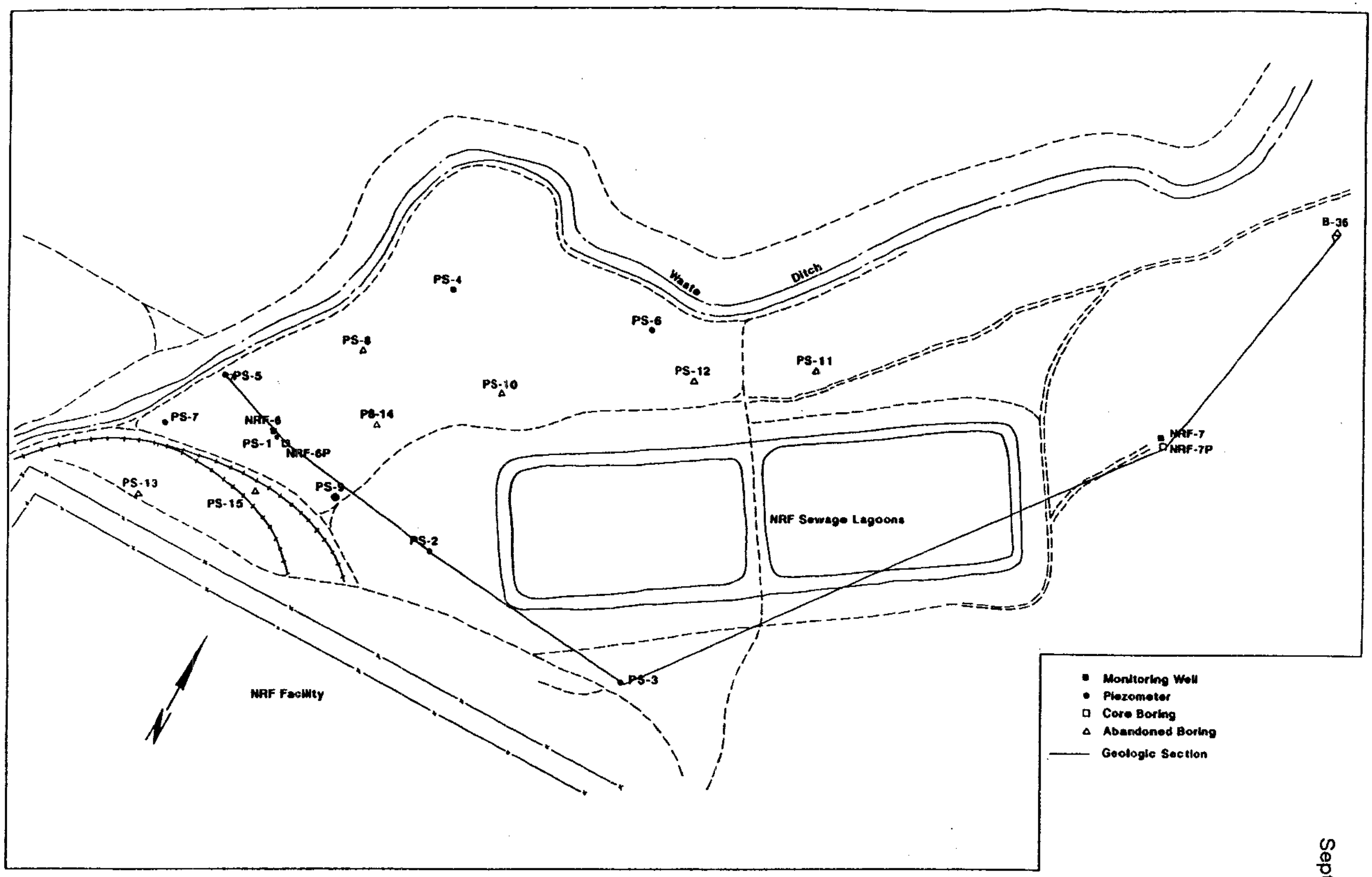


Figure 2-22 Location of Bore Holes and Monitoring Wells Drilled During 1991

no perched water was identified. The aquifer is located at approximately 364 feet in both wells.

2.8.3 Piezometer Borings

Fifteen shallow piezometer borings were drilled at depths varying from 96 to 115.5 feet. The purpose of these borings was to better define and understand the perched water system found near the IWD. Seven of these borings were completed as piezometer wells and eight were plugged and abandoned. The locations of both the completed wells and abandoned boreholes are shown in Figure 2-22. NRF is currently using in-hole data-loggers to collect data on the water level changes in the holes. This data will be provided in the final RI/FS Report.

2.8.4 Analysis of Sediment and Basalt Cuttings

During the drilling of monitor wells and piezometer wells, samples of the drill cuttings were collected and analyzed. Samples of the fluids used in drilling were also analyzed. Analyses performed included volatiles, semivolatiles, and metals. The volatiles and semivolatiles included the EPA target analyte list and a library search for unknown compounds. There were two samples analyzed for organics, one each from wells NRF-6 and 7. Several samples were analyzed for Total Metals including lead, chromium, silver, mercury, and nickel. Six samples were analyzed for an additional 8 metals. Tables 2-20, 2-21, and 2-22 summarize the data from these analyses. Table 2-20 includes those organic analytes detected that were not detected in the drilling fluids. Table 2-20 shows the mean concentration, the highest and lowest detected values for each inorganic analyte, the standard deviation and the number samples in the calculation. The samples where no analytes were detected were not included in the calculations.

2.8.5 Ground Water Analysis

Two ground water samples were collected from the perched water zones encountered during the drilling of NRF-6. These samples were analyzed for major ions, nutrients, metals, VOCs and SVOCs. Only one organic compound, hexanol, was found (6 μg/l). This was in the sample taken from the 85 foot perched water zone. A duplicate and samples from piezometer wells PS1 and PS5 were also analyzed for metals and major ions. The results of these samples are summarized in Table 2-23. Only the results that were significantly above up gradient wells (USGS 12, 15 and 17) are listed in the table.

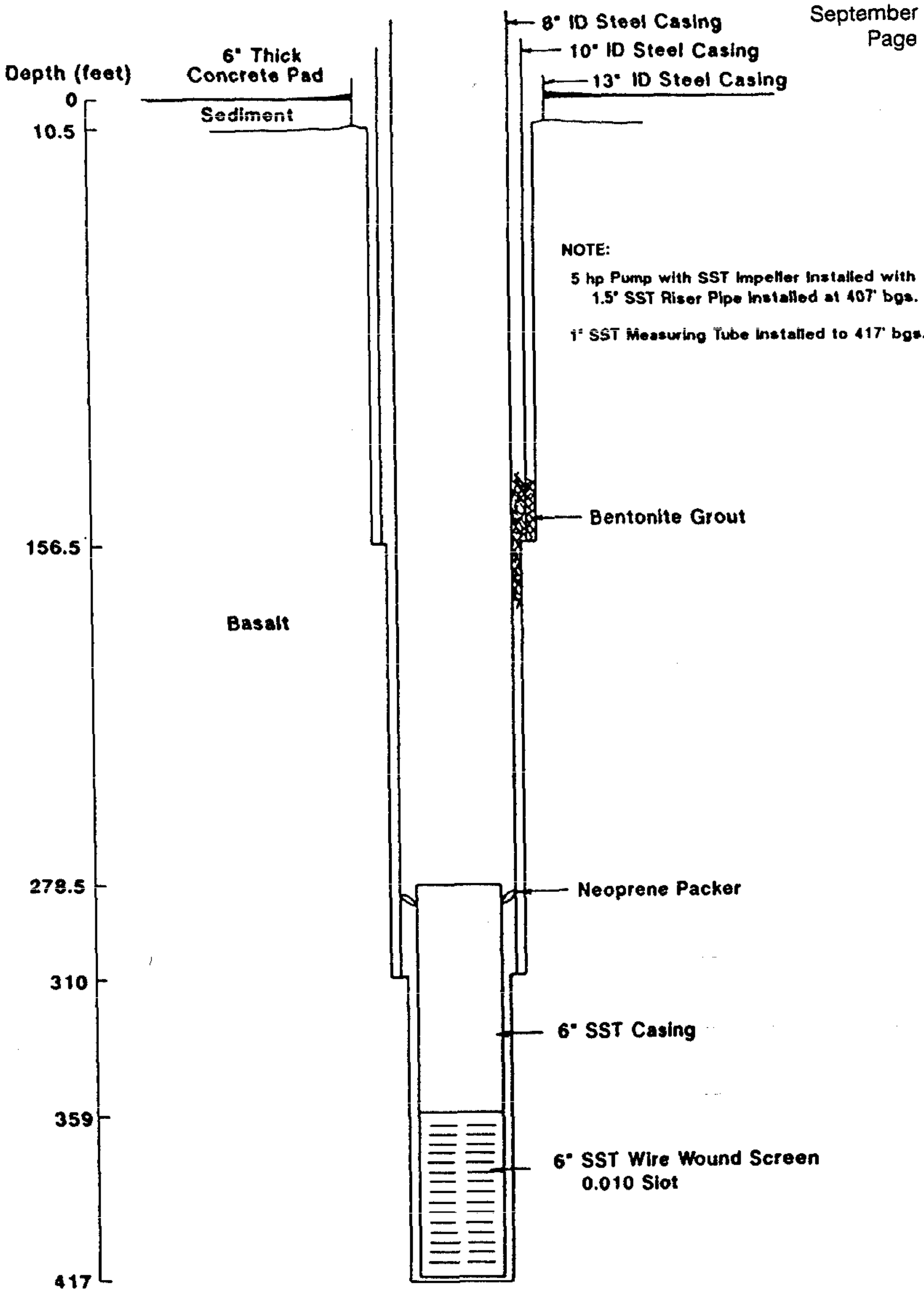


Figure 2-23 NRF-6 Well Completion Diagram

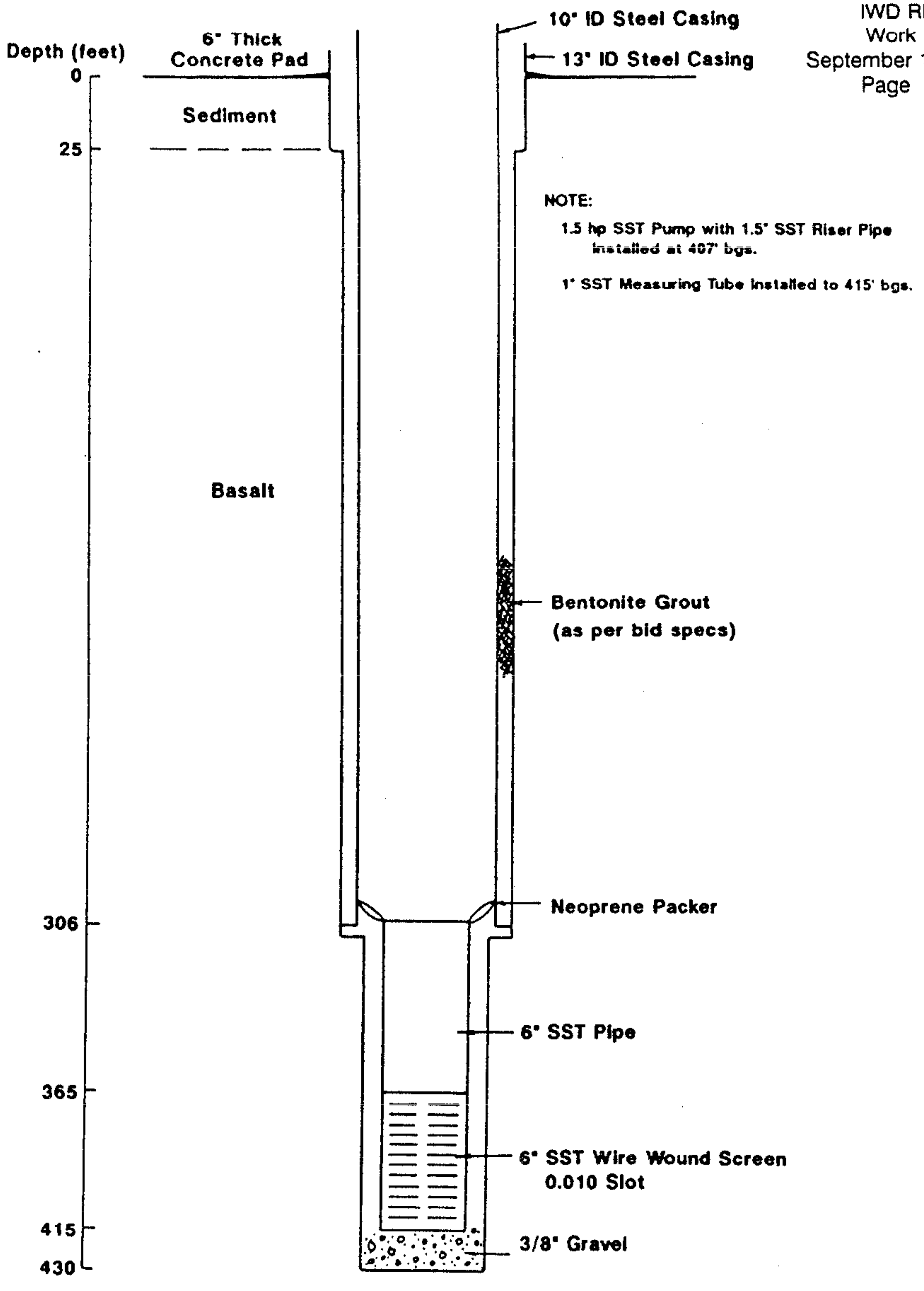


Figure 2-24 NRF-7 Well Completion Diagram

Table 2-20 Organic Analyses of Drill Cuttings

Units are in mg/kg					
ANALYTE	NRF-7 379'-384'	QL	NRF-6 86'-88'	QL	Method
2-Hexanone	.035	.014	ND	.010	CLP
Bis(2-ethylhexyl) phthalate	5.7	.450	15.2	.340	CLP
Di-n-octyl phthalate	ND	.450	2.3	.340	CLP
Propanal	.016	*	ND	*	CLP
Pentanal	.011	*	ND	*	CLP
Furan,2,5-dimethyl	1.8	*	1.3	*	CLP
2-penten-2-one, 4-methyl	ND	*	.42	*	CLP
2-pentanone, 4hydroxy-4-met	ND	*	6.6	*	CLP
Hexanedioic acid, Dioctyl Es	ND	*	.56	*	CLP

* No quantitation limit, Tentatively Identified Compound, values are estimated.

Method is from the Library search done as part of CLP method of analysis for organics. The values for the metals are typical for Snake River Plain Basalts. There were no significant elevated levels of silver or mercury. Silver was detected in 6 of 91 samples with the highest level at 10 ppm and the lowest detected at 8 ppm. Mercury was not detected in any of the samples. The other analytes are tabulated below for NRF-7 and NRF-6 in Tables 2-21 and 2-22.

Table 2-21 Summary of Metals in Drill Cuttings (NRF-7)

NRF-7 Units are in mg/kg						
Analyte	Mean	S_x	Hi	Low	Detection Limit	No. of Samples
Chromium	50	17.55	102	20	1.0	38
Lead	5.85	3.78	17	.9	1.0	43
Nickel	97.47	40.6	170	16	4.0	42

Table 2-22 Summary of Metals in Drill Cuttings (NRF-6)

NRF-6 Units are in mg/kg						
Analyte	Mean	S_x	Hi	Low	Detection Limit	No. of Samples
Chromium	40.86	15.31	86	20	1.0	44
Lead	2.99	1.55	7.5	.8	1.0	40
Nickel	102.95	36.2	225	57	4.0	44

Table 2-23 Summary of Metals and Major Ions in Perched Water Samples

SUMMARY OF METALS AND MAJOR IONS IN PERCHED WATER SAMPLES Units are in mg/l						
ANALYTE	NRF-6 @85'	NRF-6 @110.5'	NRF-6 @110.5' dup	NRF-6PS-1	NRF-6PS-5	Methods Used
Chloride	324	454	453	352	425	EPA 600
Sulfate	257	299	301	292	284	EPA 600
Calcium	116	162	162	140	167	EPA 600
Magnesium	38	30	30	36	46	EPA 600
Sodium	206	248	243	236	244	EPA 600

2.8.6 Mineral Identification Analyses

Two types of mineral identification analyses were performed on samples from NRF-6P and NRF-7P. Thin section analysis was completed on a total of 51 samples from both well borings. The basalts in NRF-6P and NRF-7P were generally classified as transitional olivine to alkaline olivine basalts. Minerals present in thin section analysis included a magnesium olivine, clinopyroxene (titaniferous augite), calcic plagioclase, spinel group minerals (possibly chromium spinel), and opaque minerals (generally ilmenite and/or magnetite). In addition, thin sections contain a microcrystalline matrix and glass. Five interbed samples were analyzed in thin section. The sediments could all be generally classified as lithic wackes. The term lithic wacke was used by Chen Northern to describe specimens of sandstone with high clay content and the high presence of rock fragments other than quartz and chert.

X-ray diffraction was performed on 11 samples, generally on sediment interbeds and fine grained clay and clayey silt infilling fractures in the basalt. Results indicate that montmorillonite is the dominant clay, while illite forms the secondary clay type.

2.8.7 Hydraulic Conductivity Tests

Ten samples each were taken from NRF-6P and NRF-7P from varying depths and tested for hydraulic conductivity. Test results indicate that the vertical hydraulic conductivity of intact basalt core samples from the two borings range from 10^{-5} to 10^{-10} cm/sec. Horizontal hydraulic conductivity values of intact basalt from the two borings range from 10^{-5} to 10^{-9} cm/sec. Horizontal hydraulic conductivity values were typically higher than vertical values.

2.8.8 Geophysical Logs

The U. S. Geological Survey (USGS) performed down hole geophysical and video logging of the monitoring wells and piezometer borings drilled during this investigation. Due to equipment availability, the types of logs obtained for each hole varied. The minimum log types obtained for the holes included video, caliper, and natural gamma logs. Other logs that were obtained from some bore holes include deviation, neutron, dual density, SP, and gamma-gamma.

3.0 INITIAL EVALUATION

3.1 Description of Operable Unit

The NRF effluent discharge system is a complex network of interior uncovered channels and buried pipelines approximately 24,000 feet (4.5 miles) long located within the facility, and a 3.2 mile uncovered exterior channel located in the northwest corner of the facility and extending in a northeasterly direction. It is this uncovered, exterior portion of the system which is the subject of this work plan. As previously stated, IWD shall mean only the exterior portion of the effluent discharge system; that is, the 3.2 miles located outside the NRF Security fence. The IWD is located in an abandoned meander channel associated with historical flow in the Big Lost River drainage, but is now isolated by canals and roads. The IWD has been used since 1953 for liquid waste disposal and has evolved into a significant ecological feature. The IWD currently is used by a variety of fauna and supports the growth of various floral species (See Appendix F). The IWD normally has water flowing in the first 1.2 to 1.8 miles. Beyond the initial 1.8 miles the IWD is usually dry, except during short, infrequent periods of heavy run-off.

The interior discharge system located within the facility includes multiple uncovered channels and buried pipelines that are routed toward the northwest corner of NRF. These channels and pipelines were designed to dispose of a particular waste water stream to the IWD. All of the waste water streams are connected to a four foot diameter culvert that drains to the IWD. Due to the considerable differences between the exterior channel and the interior network, these two portions of the effluent discharge system have been separated for the purposes of this investigation. The risk associated with the interior single waste disposal portions of the discharge system is significantly different from the combined IWD discharge due to differences in hydraulic loading and the fact that each part of the interior system handled different processes. Only the exterior channel will be covered in this RI/FS. The interior network will be investigated under a Track 2 study. This approach will allow for the evaluation of the interior network in a streamlined manner and not divert resources away from the exterior channel remediation activities.

The IWD has two distinct sections: from zero to 1.8 miles, where water has historically been seen; and from 1.8 miles to 3.2 miles, where water has not been historically observed. Existing data indicates that some contaminants (notably chromium) may be present beyond 1.8 miles. The first 1.8 miles of the IWD represents the worst case scenario for calculating the risk associated with the IWD.

The NRF sewage lagoons are located near the IWD. Although the sewage lagoons are not being considered as a potential contaminant source in this RI/FS, the hydrologic impact of the sewage lagoons will be considered in determining the aquifer and perched water recharge. The perched water tables and the Snake River Plain Aquifer are potential receptors, and are not evaluated as part of the Operable Unit. The recharge from the sewage lagoons is estimated to be an order of magnitude less than the recharge from the IWD.

The sewage lagoons will be addressed as a separate potential contaminant source in a separate operable unit. The combined effect of all operable units including the IWD and sewage lagoons will be addressed in the NRF Comprehensive RI/FS. For investigation purposes, the operable unit is defined as the IWD sediments and dredge piles, and their potential secondary sources and associated pathways as discussed in Section 3.4.2 and illustrated by Figure 3-1.

3.2 Remedial Action Alternative Evaluation

The process of evaluating and selecting a remedial action is an iterative process. Initially, Preliminary Remedial Action Objectives (PRAO) and preliminary remedial action alternatives are identified. The PRAOs are risk based clean up criteria for the identified contaminants of concern derived from existing data and EPA guidance (EPA 1991a). By identifying PRAOs early in the process, a focus is provided for subsequent data gathering. The PRAOs identified in the scoping effort are presented in Table 3-1.

The second step in selecting a remedial action is to reevaluate the PRAOs to define more specific remedial action objectives. This effort requires detailed knowledge of site conditions, contaminants of concern, affected media, available technologies, and potential future site uses. At this time, the IWD remains insufficiently characterized with respect to both the nature and extent of contamination; consequently, formulation of detailed objectives is presently impractical. Objectives will be developed based on the results of the RI, Baseline Risk Assessment, and evaluation of ARARs. Table 3-1 also lists regulated contaminant levels in water. These values are included for comparison purposes and represent potential chemical specific ARARs that may affect final remedial action objectives.

Four preliminary remedial action alternatives have been identified through the scoping effort for this RI/FS. Other remedial action alternatives may also be identified during the RI/FS process. All remedial alternatives will be evaluated during the feasibility study, and the most appropriate alternative will be selected for future remedial actions. The four remedial action alternatives identified are discussed below.

- **No Action**

  The no action option requires no remedial actions at the IWD. Maintenance work and improvements, such as dredging when plant material causes major obstructions in the IWD channel may be conducted to improve IWD operations. In addition, although not part of any specific remedial action, NRF plans to build an effluent control monitoring station and to modify the IWD channel to provide a means to control spills and minimize any future potential release of regulated wastes from NRF.

Table 3-1 Preliminary Remedial Action Objectives (PRAO)

ANALYTE OF CONCERN	METHOD	MDL		REGULATED LEVELS(b)	PRAO (a)		HIGHEST LEVELS DETECTED	
		WATER ug/L	SOIL mg/kg	WATER ug/L	WATER ug/L	SOIL mg/kg	WATER ug/L (d)	SOIL mg/kg
Chromium (III)	218.2-M	20.	1.	100	40,000	(c)	48	1200.
Chromium (VI)	218.2-M	20.	1.	100	200	(c)	(d)	19.
Lead	239.2-M	50.	0.5	(c)	N/A	N/A	8	50.
Mercury	245.1-M	5.	0.25	2	10	(c)	0.1	48.
Silver	200.7-M	10.	0.5	50	100	800	< 1.0	10.
Barium	2007-M	10.	0.5	1000	3000	20,000	200	283.
Copper	2007-M	10.	0.5	[1300]	3000	20,000	16	220.
Nickel	2007-M	40.	2.	[100]	700	5000	31	130.
Zinc	2007-M	10.	0.5	(c)	700	50,000	190	696.
Toluene	624-M	5.	1.	1000	3000	50,000	ND	0.001
Acetone	624-M	50.	10.	(c)	4000	30,000	ND	0.059
Di-N-butyl-phthalate	629-M	100.	1.	(c)	4000	30,000	ND	0.44
bis(2-ethylhexyl)phthalate	625-M	10.	1.	[4]	[6] 700	[50] 500	ND	40.7
2(3H)dihydro-furanone	625-M	N/A	N/A	(c)	(c)	(c)	ND	190.
di-N-octyl-phthalate	625-M	10.	1.	(c)	700	5000	ND	4.3

(a) PRAO's are risk based concentrations from the EPA Region 10 Supplemental Risk Assessment Guidance for Superfund. Values in brackets [] are based on HQ=1, other values are based on risk of 10^{-6}.

(b) Regulated levels are MCLs from the referenced EPA Region 10 guidance. Values in brackets are MCLGs or proposed MCLs. These values are for comparison purposes and represent potential chemical specific ARARs.

(c) Values not provided in referenced guidance document

(d) 1990 and 1991 SRPA data for on-site wells only. Chromium values are total chromium.

N/A = Not available

ND = Not detected

-M = Modified methods specified in CLP SOW

- **Sediment Removal**

  This remedial alternative involves complete removal of all material at the IWD which contains hazardous constituents above background levels. Two options exist for removal: shipment of removed sediment to an off site treatment, storage, and disposal facility; or treatment at the IWD and then replacing the material in the IWD.

- **In situ Treatment**

  In situ treatment may involve soil washing or solidification in place to treat contaminants of concern.

- **Cap and Leave in Place with Ground Water Monitoring**

  Capping and leaving the sediments in place with ground water monitoring involves treating the IWD as a landfill and then providing another source for discharge of industrial waste water from NRF.

During the RI/FS process, all remedial action alternatives identified will be screened. As more data is obtained, the remedial action objectives are revised as necessary. Also during the RI/FS process, treatment technologies are evaluated for applicability and implementability. Finally, the best potential remedial action alternatives are evaluated against the remedial action objectives and the EPA remedial action evaluation criteria:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs
- Long-term Effectiveness and Permanence
- Reductions in Toxicity, Mobility, and Volume Through Treatment
- Short-term Effectiveness
- Implementability
- Cost
- State Acceptance
- Community Acceptance

3.3 Preliminary Identification of ARARS

ARARs are restrictions or regulations that must be satisfied during site remediation. ARARs play an important role in determining which remedial alternatives may be applied to a site. Early identification of ARARs is important for the RI scoping process because specific data are often needed to design or select remedial alternatives. The RI/FS process is of an iterative nature; therefore, ARAR identification and screening continues throughout the process as a better understanding of site conditions, site contaminants, and remedial action alternatives is gained. A detailed discussion and preliminary identification of ARARS is provided in Appendix G.

3.4 Risk Assessment

3.4.1 Introduction

NRF will perform a baseline Risk Assessment in accordance with the guidance provided in the EPA's Human Health Evaluation Manual (HHEM) (EPA, 1989a) and supplemental guidance prepared specifically for EPA Region X (EPA, 1991a). Any revised guidance prepared for EPA Region X will be considered as it is issued. This section focuses on discussions related to implementation of the guidance for the NRF IWD. The emphasis is on the pathways and scenarios that specifically apply to this system. The strategy for the risk assessments will be to first conduct the calculations in accordance with EPA recommended approaches. Then, based on improved understanding of the system, supplemental calculations may be conducted using alternative inputs or methods deemed more appropriate for site-specific conditions.

The assessment of risk is a two part process; the assessment of exposure, and the assessment of toxicity of the chemicals of concern. These two aspects are combined to develop the risk characterization for each of the potential exposure scenarios. A Conceptual Site Model (CSM) has been developed and is discussed below. The CSM identifies the primary and secondary sources, the exposure pathways, the receptors, and the exposure scenarios that will be addressed in the Baseline Risk Assessment which will be included in the RI report.

The CSM identifies both human and ecological receptors. The risk to human receptors will be quantitatively evaluated in the baseline risk assessment. Ecological receptors will be qualitatively addressed in the RI/FS report for this OU. Additional ecological assessments will be performed during the NRF comprehensive RI/FS and the INEL comprehensive RI/FS (WAG-10).

3.4.2 Conceptual Site Model (CSM)

Based on existing information, a CSM of the IWD has been developed. This site model includes sources, pathways, and receptors of contaminants found in the IWD. This model, shown in Figure 3-1, will be used to develop a Baseline Risk Assessment and to help focus the RI/FS activities. As discussed in Section 2, the IWD has been in existence since about 1953. It has received non-radioactive industrial waste waters generated by operation of facilities at the NRF. The following paragraphs summarize the information that is known about the contaminants of the IWD.

3.4.2.1 Sources

The primary source of contaminants in the IWD are the sediments in the IWD and dredge piles on the banks. Historically, discharges of rain and snow runoff, industrial waste water, cooling systems water, ion exchange regeneration solutions, and liquids from various operations were discharged to the IWD. The disposal of dilute solutions of waste containing heavy metals was discontinued in 1980. The potential contaminants that have been identified based on historical operations are heavy metals and organics. These contaminants were released to the ditch through spills or by regular discharges to the IWD as part of routine operations. The volume of waste discharged to the IWD is discussed in Section 2.3 and is not repeated in this section.

The contaminants are released to secondary sources through dissolution and flooding, leaching into sediments, and percolation downward to the basalt, interbeds, and perched water zones. The secondary sources are the flood deposits, sediment infilling, interbeds, basalt, and perched water. These secondary sources may release the contaminants through air, wind, and water pathways as well as through the ecological food chain pathway.

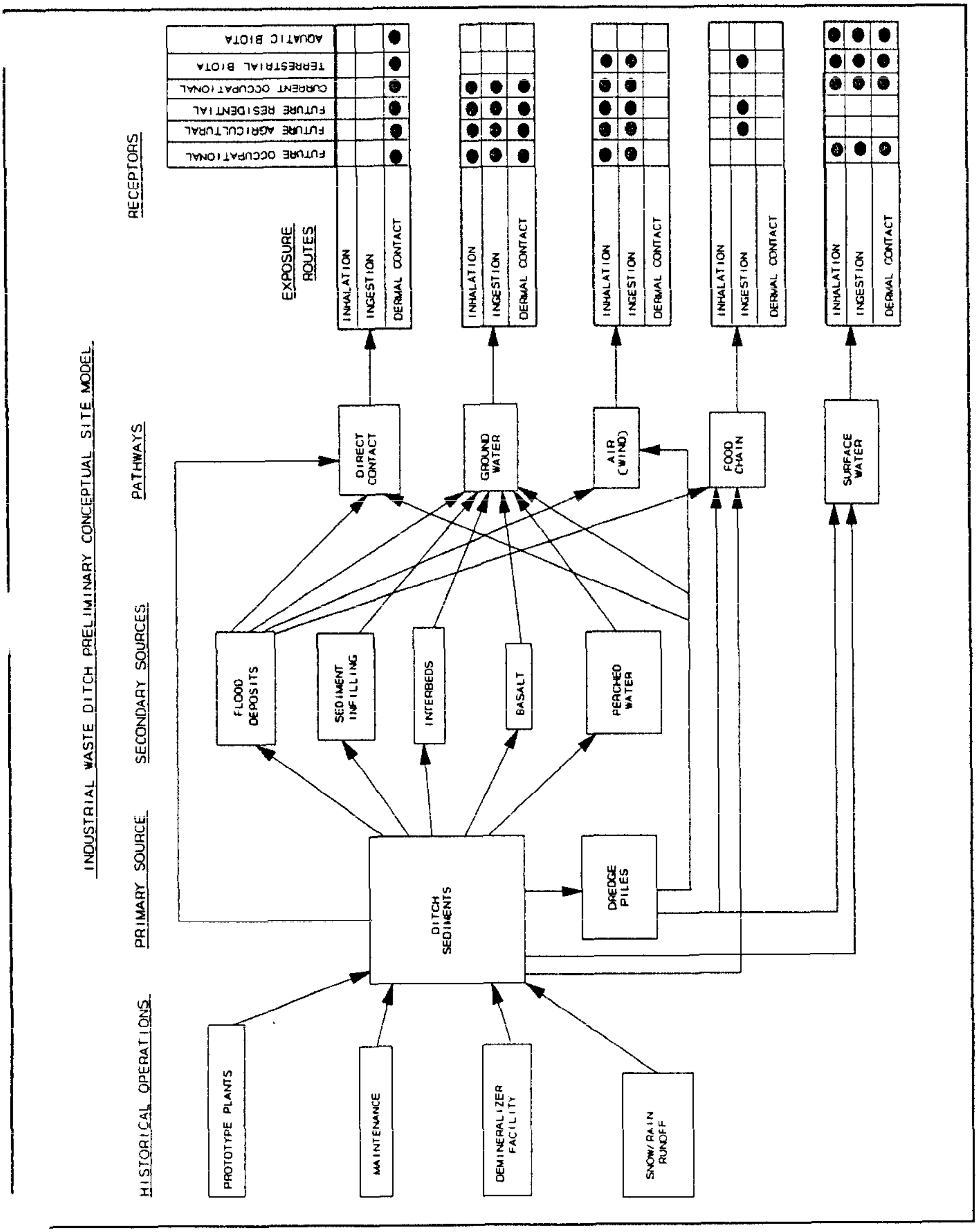


Figure 3-1 IWD Conceptual Site Model

3.4.2.2 Pathways

The pathways associated with the IWD for contaminant transport to potential receptors are: direct contact with the ditch sediments or the dredge piles, ground water or air; through the food chain; and by surface water. Contaminants released to the IWD either remained in solution, were deposited in the IWD sediments and taken up by the algae, reeds, and vegetation growing in the ditch, percolated into the ground water, or were absorbed by the soil.

Contaminants that remain in the surface water in solution, in sediments, or in dredge piles would be available for direct contact to ecological and human receptors. Some contaminants could percolate downward to the ground water where they could be dispersed to receptors. The contaminants in the sediments could be released if the ditch dried up or when the sediments are dredged and the dredge piles dry up. The contaminants would subsequently be dispersed by the wind. Reeds and algae growing in the ditch could uptake contaminants from surface water or sediments. These plants could then be eaten by various herbivores and the contamination passed up the food chain.

The routes of entry to the receptors are by inhalation, ingestion, or direct dermal contact. The Baseline Risk Assessment will address all pathways as shown in Figure 3-1.

3.4.2.3 Receptors

Current and future occupational exposures to human receptors include: inhalation of volatiles or fugitive dust; ingestion of contaminated soils, ground water or surface water; and direct contact with soils, sediments, dredge piles, ground water, and surface water. Future agricultural and residential scenarios include these same pathways and the possibility of ingestion of contaminants through the food chain.

Ecological receptors include terrestrial and aquatic biota. Terrestrial biota may be exposed through direct contact with sediments, flood deposits, and surface water in the ditch. They could also be exposed from inhalation of dust, ingestion of contaminated plants, water, or soils, and through the food chain. Aquatic biota exposures could result from direct contact with sediments, dredge piles, or surface water and by inhalation or ingestion of contaminants from surface water.

The regional aquifer flow beneath NRF is generally in a southerly direction. All NRF production wells, which are located approximately one half mile south of the IWD outfall, have been historically monitored, and no heavy metals related to the IWD have been detected. Since regional aquifer flow is generally to the south, the nearest ground water pathway receptors for the current occupational scenario will be NRF and Test Reactor Area (TRA) workers. Future agricultural and residential receptors would be farmers and ranchers using ground water for drinking and domestic uses. These same receptors would also be exposed to air and wind pathways for inhalation and ingestion, as well as direct contact with the contaminants at the site.

Future agricultural and residential scenarios will take into account that the water in the ditch is generated by current operations and will not be present during any future use other than occupational. The only receptors for the surface water pathway is therefore current and future occupational and biota. The exposure point used in the baseline risk assessment for the future residential and future agricultural scenarios will be at the IWD. The exposure point for occupational will also be at the IWD. There is no current or future occupational exposure to the food chain pathway. Only future residents, ranchers and hunters are reasonable receptors for this pathway. The terrestrial and aquatic biota are the receptors for the surface water pathway through inhalation, ingestion, and dermal contact, as the ditch has created a source of water for various plants and animals. Ecological receptors include green and blue-green algae, reeds, vegetation growing in the ditch, and animals using the IWD as a water source. Food chain receptors would include herbivores that may ingest contaminated plants, secondary and tertiary consumers, and humans that may ingest contaminated game animals.

3.4.3 Exposure Assessment

Exposure assessment is conducted in three steps: characterization of exposure setting; identification of exposure pathways; and quantification of exposure. The procedures are based on EPA's guidelines (EPA, 1989a) and other related guidance (EPA, 1988a, 1991b). The methods discussed below will be used for the NRF IWD system. The exposure assessment process begins after chemical data has been collected and validated, and the chemicals of potential concern have been identified. The SAP has been designed to provide the necessary data to estimate the contaminant concentrations in the IWD. As further data are obtained, supplemental calculations may be used as needed to accurately represent the NRF IWD system.

3.4.3.1 Characterization of Exposure Setting

At the INEL, including NRF and its immediate surrounding areas, there are no nearby resident or sensitive populations. There are, however, approximately 2000 workers employed at the NRF, with another 1000 employed at TRA, seven miles to the south. The nearest resident population is located in Mud Lake (1990 population - 243), which is approximately 30 miles northeast of the NRF. Other significant resident populations exist at much greater distances from the NRF, with Idaho Falls (1990 population - 39,590) located approximately 50 miles to the east of INEL, Blackfoot (1990 population - 10,065) located approximately 41 miles southeast, and Arco (1990 population - 1241) located 25 miles to the west of INEL.

For each possible pathway, the location of the highest reasonable individual exposure (referred to as "significant exposure point") will be determined. Assessments for future impacts will not be limited to existing populations. Projections will address future residential and agricultural uses. At each significant exposure point, long-term exposures will be determined.

3.4.3.2 Identification of Exposure Pathways

The sources of contamination and the mechanisms and pathways of transport were discussed previously in Sections 3.4.2.1 and 3.4.2.2. This section of the report will reiterate the previous findings and discuss portions specific to the risk assessment process. Figure 3-1 shows the relationship between various contaminant sources and transport processes, as well as exposure routes. Receptors are addressed in Section 3.4.2.3. If it is determined during the RI that sources or processes other than those shown in Figure 3-1 are important, they will be included in the final risk assessment. All potentially complete pathways will be evaluated for risk to human health and the environment.

In addition to the determination of potentially exposed populations, the probable exposure routes for each exposure point will be determined. For the NRF IWD system, the potentially significant exposure media include air, ground water, direct contact with soil, bioaccumulation through the food chain, and surface water.

3.4.3.3 Quantification of Exposure

Once the suite of contaminants has been determined for the IWD, constituent concentrations at receptor points will be determined. In order to accomplish this, the reasonable maximum exposure (RME) will be defined to narrow the receptor location scope. The RME defines both the type of human receptor (i.e., resident, worker, etc.), as well as the location of the receptors for expected present and future uses.

Because the temporal or spatial range may not extend to the location of the receptors, it may be necessary to supplement actual field data with data derived from fate and transport equations and models. Much of the data collection and analysis work defined in the FSP was included specifically to support fate and transport models as discussed in this work plan. Statistical analysis of monitoring data will include calculation of mean concentrations with standard deviations and using the "Student's" t test for comparison to background concentrations to establish confidence intervals for the maximum contaminant concentration. Non-detected compounds will be treated as being one half of the minimum detection level listed for that set of data and analysis. All statistical methods and exposure calculation methods have not yet been determined and will be identified and explained in the final report.

3.4.3.4 Estimation of Exposure Point Concentrations

The contaminant concentrations at the exposure points for the various exposure scenarios will be determined by the use of mathematical models. Airborne ground water exposure pathways will be modeled using EPA and IDHW approved models which will be selected based on data collected during the RI process.

Many parameters are required to estimate the fate and transport of the contaminants. Site-specific parameters such as soil porosity, organic carbon content, particle size, Cation Exchange Capacity (CEC), transmissivity, and hydraulic conductivity must be determined for the particular setting. This site-specific information will be gathered during the sampling and analysis portion of the RI.

Contaminant-specific properties such as solubility, octanol/water partition coefficient, and soil sorption coefficient can be found by one of three methods;

analytical methods, literature search, or estimation methods using available data. For most chemicals in use today, sufficient experimental data have been gathered, making it unnecessary to resort to costly analytical methods to determine chemical-specific properties. For those chemicals that may not have the experimental data available for a particular property, sufficient data usually exists to estimate the required property. The primary method that will be used in this RI/FS effort will be a literature search.

The sources that will be used include, but are not limited to:

- Track 1 Sites: Guidance for Assessing Low Probability Hazard Sites at INEL - EG&G
- Track 2 Sites: Guidance for Assessing Low Probability Hazard Sites at INEL - EG&G
- EPA Standard Default Exposure Parameters
- CRC Chemistry and Physics Handbook
- Other EPA promulgated documents that contain parameters of interest.
- Trade journals and other trade books
- Scientific journals and published data

Potential models that are being considered for use in modeling the ground water include GWSCREEN, written and published by EG&G for INEL application, MODFLOW, and MODPATH. Section 4.4.5 of the Work Plan and Section 3.6 of the FSP discuss potential ground water modeling efforts.

3.4.3.5 Estimation of Chemical Intakes

Chemical intakes must be estimated to assess the risk posed by exposing an individual or population to contaminants. Intakes will be different, depending on the definition of the RME. As discussed previously, the definition of the RME includes a description of the receptors (resident, worker, etc.) and their locations. The intake quantities for each pathway depend on the specifications for the RME. Chemical intakes will be calculated based on Region 10 Supplemental Guidance to Risk Assessment for Superfund - Standard Exposure Default Parameters. This guidance (EPA, 1991a) will be used for standard inputs (e.g., body weight, breathing rates, soil ingestion, exposure durations, averaging times, etc.) with modifications due to site-specific considerations (considered as sensitivity cases to the default EPA inputs). Site specific calculations will then be compared with results using standard EPA exposure assumptions. Office of Solid Waste and Emergency Response (OSWER) Directive 9285.6-03 (EPA, 1991b) will also be consulted for guidance on default exposure assumptions for many pathways and receptors.

As discussed in Section 3.4.2 (CSM), the pathways of concern are ground water, wind, direct contact, bioaccumulation in the food chain, and surface water. The chemical intake used in the risk assessment will be a combination of intakes through each of these pathways, as appropriate. The ground water pathway intakes, for example, will include inhalation and dermal contact due to residential use (i.e., showers as well as ingestion from drinking water). Total intake will be a summary of the intakes due to each exposure pathway applicable to a specified receptor. Intakes for each receptor will also be determined for subchronic and chronic exposure times as specified in the Human Health Evaluation Manual (HHEM) and EPA Region 10 supplemental guidance. The resulting intakes defined as subchronic daily intake and chronic daily intake will be established. Finally, by combining the individual route exposures from each pathway, the total daily intake from ingestion and inhalation will be found for each intake duration.

3.4.4 Toxicity Assessment

Toxicity assessment summarizes the toxicity information for a chemical and is conducted prior to the risk characterization process. Toxicity information and the exposure assessment results are used to characterize risks. The toxicity information consists of values that describe the degree of toxicity of a chemical. EPA guidance will be used for toxicity data (EPA, 1991b; and Integrated Risk Information System - IRIS). For chemicals not listed in EPA guidance, toxicity information is also available through the Environmental Criteria and Assessment Office of EPA. This office will be contacted if insufficient information exists in EPA's guidance documents or data bases.

Three parameters are used for the evaluation of nonradioactive toxicity:

- Verified (or non-verified, if necessary) subchronic reference doses (RFDs)

- Verified (or non-verified, if necessary) chronic RFDs

- Slope factors (for carcinogenic effects)

3.4.5 Risk Characterization

The final step in the overall risk assessment process will be to combine the information obtained from the chemical intake and toxicity steps to arrive at a quantified risk. This risk assessment step is concerned with two types or components of risk; chemical non-carcinogenic and chemical carcinogenic. The first component, chemical non-carcinogenic risk, uses exposure information in conjunction with subchronic and chronic toxicity data to determine non-carcinogenic effects typically associated with short-term high-exposure conditions and longer-term exposures. The second component, on the other hand, uses long-term (chronic) exposures to determine carcinogenic risks associated with chemicals.

To arrive at a single value for each carcinogenic and non-carcinogenic risk present at the site, it will be necessary to combine the risks associated with multiple chemicals.

3.4.6 Uncertainties

Uncertainties associated with risk assessment procedures will be investigated. Many uncertainties exist in the determination of factors related to risk, such as toxicity values, cancer incidence rates, and exposure scenarios. Uncertainties will be discussed qualitatively in the risk assessment reports as suggested in the HHEM. Parametric sensitivity analyses will also be conducted to quantitatively illustrate the impacts of the uncertainties in inputs to the models.

4.0 WORK PLAN RATIONALE

4.1 Data Quality Objectives

Data Quality Objectives (DQOs) are qualitative and quantitative statements which specify the overall quality of data required to support the various remedial action response activities (RI, FS, risk assessments, and preliminary design). They vary based on site conditions and data uses; therefore, it is undesirable to establish uniform DQOs for all RI/FS work. The DQOs are established as part of project scoping and planning.

DQOs should be specified for each data collection activity associated with the remedial investigation. Most of these activities will take place during the RI, including the collection of supplemental data for the FS, such as treatability studies. As revised data needs are identified during the remedial investigation process, new DQOs are developed. In fact, the establishment of DQOs is an interactive and iterative process, whereby all DQOs are continually reviewed and reevaluated during the remedial process. All investigation activities should be conducted and documented in a manner that ensures sufficient data of known and acceptable quality are collected to support sound, defensible decisions governing remedial action selection.

DQOs are usually formulated in stages. During stage one, existing information on the site is formulated into a CSM. The CSM is presented in Section 3.4.2. Stage two further identifies data uses and data needs and is presented in Sections 4.1.1 and 4.1.2. Stage three presents the actual design of the field investigation. This information is summarized in Section 4.1.3.

4.1.1 Identification of Data Uses and Data Types

Data use categories for the IWD include the following:

- Site Characterization (SC): Data are used to determine the nature and extent of contamination and site conditions. This use is usually very data intensive. The goal is to maximize the quality, including completeness of the data, while minimizing the collection of superfluous data.

- Risk Assessment (RA): Data are used to evaluate the threat posed by the site to human health and the environment. This task tends to require data of the highest quality, and often of the lowest detection limits.

- Fate and Transport Modeling (FT): Data from the RI/FS process will be used to assess the migration of contaminants through the pathways presented in the CSM (Section 3.4.2).

- Evaluation of Alternatives (EA): Data are used to evaluate various remedial technologies and alternatives for site remediation. The data must be good enough to distinguish between different alternatives, to evaluate the likely effectiveness of the alternatives, and to cost the alternatives for comparison purposes.

- Engineering Design of Alternatives (ED): Data from the RI/FS can be used to develop conceptual and actual remedial designs. Although that task is beyond the scope of the current work plan, collection of data useful to that task should be considered throughout the RI/FS process, especially if the data can be collected for significantly less cost during the RI/FS.

- Health and Safety (HS): Monitoring data from the field during RI/FS data collection activities is used to establish and assure compliance with a level of protection necessary for on-site contractors. Since these contractors often have a high potential for directly contacting contaminants during the investigation, it is critical that the health and safety of their environment be monitored.

4.1.2 Data Quality Needs

The data needs for this RI/FS project have been established based on the review of existing data, evaluation of the CSM, and a preliminary risk evaluation. Table 4-1 lists the needed data by data type and identifies the data uses, data quality levels and data collection methods. The selection of the data quality levels was based on two primary considerations: the use of the data, and the PRAOs, or, when the PRAOs are unavailable, EPA risk-based numbers for drinking water and soil ingestion for the chemicals of potential concern.

4.1.3 Stage Three DQOs

Stage three DQOs are embodied in the attached SAP, which includes the FSP, the QAPjP, and the DMP. The FSP guides the quality of the field sampling, the QAPjP specifies Precision, Accuracy, Representiveness, Completeness, and Comparability (PARCC) parameters to ensure the quality of analysis, and the DMP describes the procedures necessary to document that data are of known and acceptable quality.

Table 4-1 Summary of RI/FS Data Needs

Data Type	Data Use	Data Quality Level	Data Collection Method
Soil samples for physical properties	RA, FT	III	S/A
Sediment sampling for physical properties	RA, FT	III	S/A
Ground water elevations	FT	II	FI
Soil samples for contamination	RA, EA, SC, HS, ED	IV	S/A - CLP
Ground water field parameters (pH, temperature, conductivity)	FT	I	FI
Ground water geochemistry sampling	RA, FT	III	S/A
Ground water sampling for contaminants	HS, SC, RA, FT	IV	S/A - CLP
Topography survey data	FT	II	FI
Demographic and land use	RA	NA	LS
Climatic data	FT	NA	LS
Water supply data	RA, FT	I	FI
Air sampling	HS	I	FI
Geophysical investigations	RA FT	II	FI S/A
Stream infiltration study	RA, FT, ED	NA	Flume
Modeling	FT	NA	S/A-CLP

CLP - Contract Laboratory Program Format
EA - Evaluation of Alternatives
ED - Engineering Design of Alternatives
FI - Field Instrument
FT - Fate and Transport
HS - Health and Safety
LS - Literature Search
NA - Not Applicable
RA - Risk Assessment
S/A - Sampling and Analysis
SC - Site Characterization

4.2 Field Sampling Plan Approach

The objectives of this Work Plan are to collect, analyze, validate, and evaluate the data necessary to perform the Baseline Risk Assessment, and to evaluate the potential Remedial Action Alternatives discussed in Section 3.2. Based on existing data, a preliminary risk evaluation has been conducted to identify the primary contaminants of concern associated with the IWD. This preliminary evaluation used the CSM discussed in Section 3.4.2, and identified the data that needs to be collected during the RI process.

The FSP (Part A of Appendix B), describes the technical approach and specifies sampling methods and procedures that will be used in completing field investigation tasks at the IWD. The FSP's objective is to assure that all RI field methods and procedures are appropriate, consistent, and reliable. Appropriate, consistent, and reliable methods generate data of known and acceptable quality which are suitable for use in the Baseline Risk Assessment and FS. The FSP presents a detailed discussion of field investigation activities, including near surface soil and sediment sampling and chemical analyses, drilling and subsurface soil and bedrock sampling and physical property measurements, soil chemical analyses, ground water sampling and chemical analyses, ground water level monitoring, and surface water sampling and chemical analyses. This FSP is subdivided into two plans that best describe the scope of work for each area of concern; the Near surface Soil and Sediment Sampling Plan, and Hydrogeological Investigation Plan.

As discussed in Sections 2.4 through 2.8, several investigation projects have been conducted at the IWD. The data collected during these investigations have not been validated in accordance with EPA or NRF procedures. The existing data will be validated if adequate documentation of method numbers and detection limits can be located that will allow for validation of this existing data. The useability of the existing data for the RI/FS report is questionable at this time; however, all existing data was used in developing this work plan and the specific FSP details. The questionable value of the data from previous investigations is part of the reason that additional data will be collected.

The near surface and sediment sampling portion of the FSP has been designed to collect enough data to characterize the ditch sediments and dredge piles, and to determine the useability of the existing data. Any validated existing data will be compared to the data collected during the RI process and, if appropriate, used in the RI/FS report and decision making process. Sediment sample locations noted where existing data high concentrations of chromium will be resampled to identify trends in contaminant concentrations through time.

The preliminary risk evaluations have also identified a substantial data gap in the area of contaminant fate and transport information. In particular, the hydrogeology beneath the IWD and the current spread of contaminants are not adequately understood. The characteristics of the alluvium will have a major effect on the absorption of contaminants and their ability to migrate to the ground water. The hydrogeologic investigation portion of the FSP has been designed to collect data to understand the hydrogeology and geology of the IWD and surrounding area. This data will also support potential ground water modeling efforts. The boreholes discussed in Section 4.4.3.1 will also be used to collect samples to identify the current spread of contaminants to the alluvium surrounding the IWD.

4.3 Surface and Sediment Sampling Rationale

4.3.1 Sediment Sampling

All of the water discharged from NRF operations into the IWD enters through a single culvert at the outfall. The IWD outfall is located just north of the northwest corner of the NRF perimeter fence, and extends approximately 3.2 miles to the northeast. The wetted portion of the IWD varies with NRF operational activities. Currently, water ends at approximately 1.2 miles. Prior to the inactivation of S1W, the water normally ended at 1.6 miles, and extended to 1.8 miles during high discharge evolutions. In general, depth of water (hydrostatic pressure) decreases as the distance from the outfall increases. This factor, and therefore infiltration rate, would tend to result in decreasing contaminant concentration with increasing distance from the outfall. However, other factors such as soil physical properties and vegetation density may affect contaminant concentration levels in the sediment.

Based on the assumption that contaminant concentration decreases with distance, a tiered sampling approach will be used such that the frequency of sampling will decrease with distance from the outfall. However, to investigate the effects of other factors, the Field Sampling Plan includes an infiltration study, soil physical property analysis, and targeted sampling in addition to the tiered sampling.

For the tiered sampling, the 0.6 mile marker was used as the cutoff point for the first segment due to a visible change in the IWD vegetation and algae growth at this point. The remaining historically wetted portion of the IWD has been divided in half, resulting in three equal segments of 0.6 miles each. The fourth segment is the dry portion of the IWD from 1.8 to 3.2 miles. These tiers will be sampled on a progressively larger sampling interval. The samples will be collected in a staggered pattern, moving from the center of the channel to the right of the channel, back to the center of the channel, and then to the left of the channel.

For the targeted sampling, existing data (discussed in Sections 2.4 through 2.8) will be reviewed and evaluated to identify previous sample locations which had high analytical results. New samples will be taken as close as possible to the old sample locations at 0, 0.6, 1.4, and 1.6 miles from the outfall. These locations had the highest total chromium concentrations with values up to 1,270 ppm above background. Appendix B Part A, Field Sampling Plan Figures 2-2 through 2-4 show the targeted sample locations. This will be accomplished by adding four sample locations to those in the systematic staggered pattern discussed above.

Existing data on water infiltration from the IWD is unreliable, but does suggest that there are some areas of the IWD with higher infiltration rates than other areas. It is unknown whether this is a linear function of the distance, or a step function. The infiltration study discussed in Section 4.4.3.3 will help assess this issue. Both linear and step-wise infiltration hypotheses support the FSP scheme of assessing the IWD sediment contaminant concentration in segments.

The existing data presented in Sections 2.5 thru 2.8 also show that the contaminant levels decrease with increasing depth below the IWD bottom. Therefore, the sediment sampling will concentrate on the first 12 inches of sediments. The geological investigation discussed in Section 4.4.3 includes the collection of samples from deeper soils.

The suite of analyses that have been identified for the near surface and sediment sampling has been based on the contaminants identified in the existing data. Silver and chromium have been consistently identified at sampling locations throughout the IWD and dredge piles. Additionally, lead, mercury, and some trace organic compounds have been identified, but not as consistently nor in the concentrations found for silver and chromium. The metals listed above and some organic compounds are also known or suspected process releases based on process and operational knowledge. The samples will be analyzed for Total Metals, and TCL VOC and SVOC using exhibit D of CLP SOW OLM 01.0 (inorganics and organics respectively), and specific background indicator metals as listed in the FSP. As required in the SOW of the CLP, TICS of the VOC and SVOC will be compared to a library search. These compounds will be used to correlate sample results with background samples collected. Total Petroleum Hydrocarbons will also be in the analysis suite due to known trace releases of oil.

4.3.2 Dredge Pile Sampling

The same philosophy was used in designing the sampling plan for the dredge piles as that used for the IWD sediments. The intent of this sampling effort is to provide the necessary data to support the Baseline Risk Assessment and to evaluate the useability of existing data. Seven samples will be collected at the surface and analyzed for the eight target metals identified in the FSP. These samples are necessary to support the risk assessment work because the primary pathway for migration from the dredge piles is through wind dispersion. No analysis will be performed for VOCs on these surface samples since the dredge piles have been exposed to volatilization for at least 12 years.

Samples will be taken from 51 locations at a depth in the dredge piles approximating the middle. A second set of samples will be taken from the undisturbed soil beneath the dredge pile at the same locations. Both sets of samples will be analyzed for the identified metals. In addition, 25 percent of these locations will have samples collected at both depths and analyzed for VOCs. These samples will provide data to characterize the dredge piles and to support the risk assessment of the proposed NRF plan to perform dredging and to groom the banks of the IWD for vegetation control.

4.3.3 Wind Dispersion of Contaminants

The wind dispersion of contaminants from the dredge piles will be assessed as part of the Baseline Risk Assessment. The extent to which the contaminants have been deposited in various locations around the IWD will be an issue in this assessment. This work plan does not include the collection of samples around the IWD for the sole purpose of evaluating wind dispersion. If the baseline Risk Assessment wind dispersion modeling and dredge pile sampling indicate that contaminant dispersion poses a significant risk, then additional samples will be collected to evaluate this pathway more fully in a second round of sampling. If the risk associated with the dredge piles as the current conditions exist is not considered significant, no additional surface samples will be collected.

4.3.4 Background Sampling

Background sampling will also be performed to assist in the evaluation of the risk calculations. The background data accumulated will be used in conjunction with existing background data and data acquired from a literature search for other INEL background data. A total of 20 background sample locations were selected based on identification of undisturbed soils near the IWD, review of aerial photographs, wind rose direction, location of INEL facilities, and a literature search of other background data at the INEL. These locations may change slightly if problems are encountered during sampling, or if there is evidence that they do not represent undisturbed soil. One sample will be collected and analyzed for the selected metals identified in the FSP at each of 20 locations, and a sample will be collected for SVOC and TPH at every fifth sample location. If SVOC and TPH analyses indicate that organic contaminants are present, then the appropriateness of that background location will be re-evaluated. Since most VOCs are not naturally occurring compounds, no VOC analyses will be performed.

4.4 Hydrogeological Investigation Rationale

4.4.1 General

Data collected to date indicates that activities associated with the operation of prototype plants at NRF and the subsequent discharge of water to the IWD may have had a minor impact on the quality of the water of the Snake River Plain Aquifer and perched water beneath the IWD. Refer to Section 2.8 of the Work Plan for a summary of past ground water monitoring results. Analyses results of water samples from wells NRF-6 and NRF-7 show that water from these wells contains elevated levels of chloride, sulfate, sodium, calcium, chromium, iron, aluminum, manganese, barium, and nickel. Levels of chromium in wells NRF-6 and NRF-6PS-6 are approximately 50 ppb. These levels do not exceed the MCL of 100 ppb (56 FR 3525) but are higher than levels seen in surrounding wells. A summary of the ground water monitoring data shows slightly elevated levels of many of these same constituents in on-site and down gradient wells as compared to up gradient wells (see Section 3.7.1). The full significance of these data is not yet understood, and additional evaluation is necessary to determine the source of these contaminants. The activities described in the work plan are intended to gather more data about this and other hydrogeologic problems.

Since the existing data does not indicate that contaminant levels in either the perched water or the SRPA exceed MCLs, it is not necessary at this time to include a detailed modeling effort of the perched water bodies or the SRPA. However, the Hydrogeological Investigation described below has been included in this Work Plan to further assess the current and potential impact of the IWD on both perched water bodies and the SRPA. If the data collected indicates that there are still significant data gaps relative to these ground water bodies, then a ground water modeling effort may be added to the RI/FS work scope as discussed in Section 4.4.5. The determination as to the necessity, objectives, and application of any ground water modeling work will be made by NRF, with review by the EPA and IDHW.

4.4.2 Geophysical Investigation

4.4.2.1 Gravimetric Survey and Borings

The purpose of the NRF gravity survey will be to more precisely determine the topography of the basalt surface which is underlying the surface alluvium. An interpretation of the data gathered during the gravity survey will provide information on the effect that the basalt may have on infiltration from man-made and natural recharge sources, as well as provide input for the potential hydrogeologic model.

Data collected previously at NRF indicates that the surface of the basalt may act as a semi-permeable barrier to the flow of water infiltrating from the surface. Water reaching the basalt could be directed down gradient to a remote location, and then infiltrate into deeper layers. This phenomenon could have an affect on local ground water recharge, and could be significant input data for ground water modeling programs. In ground water systems where this occurs, the difficulty of predicting contaminant transport and fate increases greatly. Before an attempt is made to assess the influence which the surface of the basalt may have on ground water hydraulics, that surface must be characterized. Gravimetric data will be collected for this purpose and verified by bore hole drilling.

All gravimeters change null readings with time, even at a fixed location. The primary cause of this phenomenon (drift) is spring fatigue within the meter, changes in gravitational pull due to earth tides, and the relative position of the moon and sun. The net result of drift is that repeated readings at one station will give a series of different gravity values. To correct for drift, some of the gravity stations must be periodically remeasured to produce a drift curve for the gravimeter. The maximum time between measurements determines the accuracy of the resultant measurement, and should not exceed two or three hours. A primary base station is established, and all drift corrections are referenced to this point. Secondary base stations are also established; the purpose of the secondary base stations is to provide a secondary reference point rather than returning to the primary base station. All secondary base stations are referenced to the primary base station. Figure 4-1 shows the survey locations.

The data collected are also corrected for elevation, latitude, and the attraction of material between the station and the reference plane. When all corrections have been made and applied to the observed gravity reading, the Bouguer gravity value is obtained. The resulting contour map of these values will represent changes in gravity readings due to variations in the topography of the basalt, and gradual changes in gravity due to deeper, large scale regional variations in geology.

One method to separate the Bouguer gravity anomaly into these two separate components is to approximate the anomalies as polynomial surfaces. It is estimated for the purpose of this study that the regional anomaly can be approximated by a 1st or 3rd order polynomial, and that the anomaly due to near surface basalts can be approximated by a 5th to 7th order polynomial. A 1st order polynomial surface is a plane. A second order surface is displayed as a series of sinusoidal waves. An n^{th} order surface matches every detail in the basalt surface. It is not possible in the scope of this RI/FS to acquire enough data to achieve an n^{th} order match; however, it is estimated that a 5th to 7th order match can be achieved using a gravity station spacing of 100 feet as shown in Figure 4-1.

To calibrate and confirm the interpretation of the gravity data, thereby more accurately characterizing the basalt surface, 25 bore holes will be drilled to the top of bedrock. Figure 4-2 is a cross section which demonstrates a profile view of the surface of the basalt. This cross section was constructed from drilling data gathered during the 1987/88 Phase I Closure Plan Sample Collection report and the 1991 Hydrogeologic Investigation. As shown by the cross section, the maximum change in elevation of this surface is approximately 40 feet, and the distance between bedrock highs ranges from approximately 200 feet to about 600 feet.

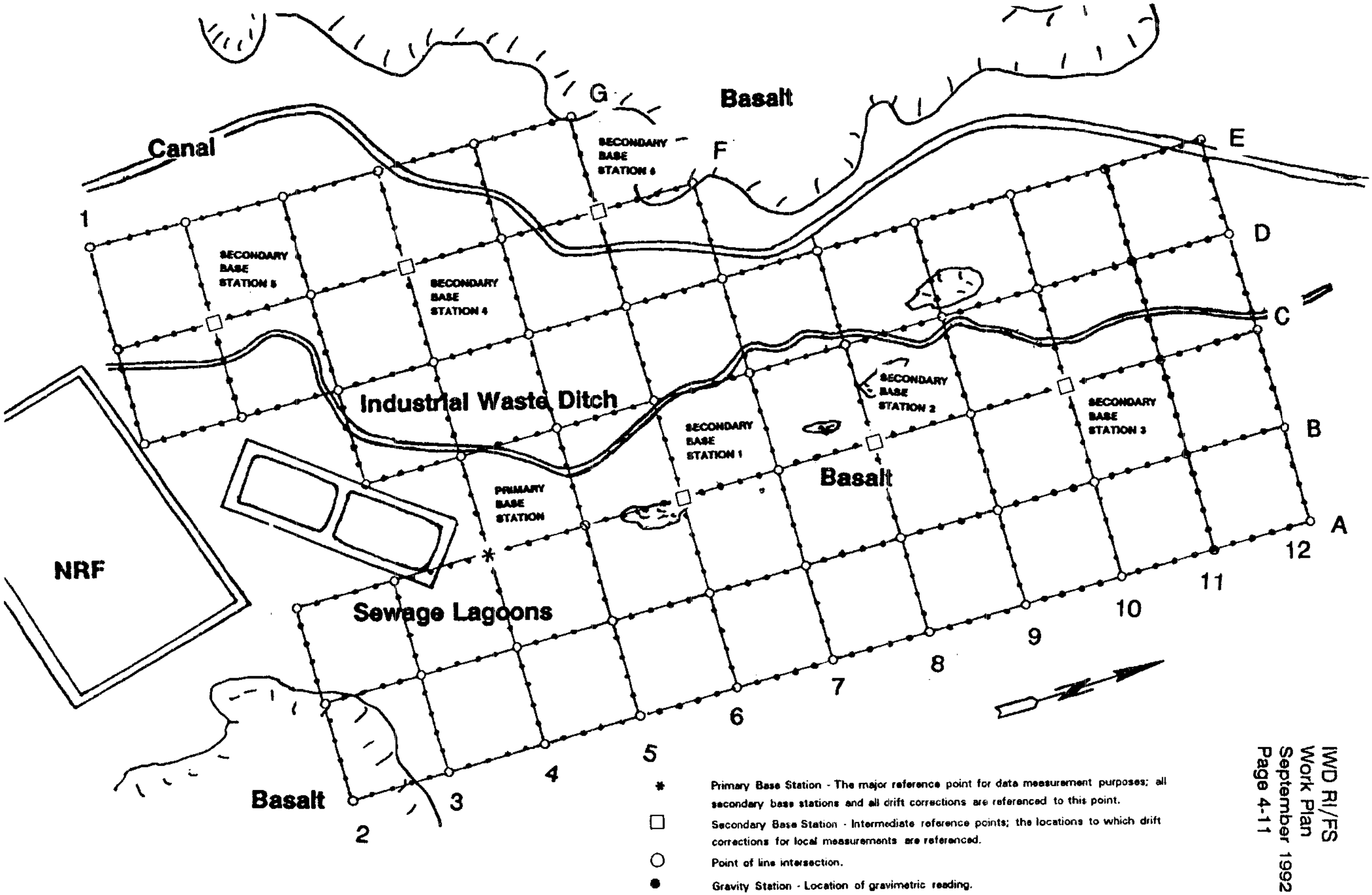
4.4.2.2 Resistivity Sounding and Profiling

The resistivity method was previously used at NRF during the summer of 1987 in an attempt to locate perched water bodies. The results of this work were inconclusive. At the time this work was performed, little was known of the stratigraphy beneath the IWD. Furthermore, the presence of perched water beneath the IWD was suspected, but nothing was known of its depth or location.

Ten resistivity soundings were performed as part of the work for the 1987/88 Phase I Closure Plan Sample Collection report. The first resistivity station was located approximately 0.6 miles from the outfall of the IWD. Other stations were progressively further from the outfall. All stations were located within 50 feet of the IWD.

During the 1991 drilling operations, perched water was found at approximately 0.1 miles and 0.4 miles from the outfall. Perched water was encountered in well PS-9, 500 feet from the IWD. Perched water was also encountered 150 feet away from the IWD in well PS-6. Because no resistivity soundings were performed before 0.6 miles, and since no exploration occurred beyond the immediate confines of the IWD, it is possible that otherwise inconclusive results may have been more successful in detecting the presence of perched water. Because most of the resistivity work was performed adjacent to the IWD, water infiltrating from the IWD could have interfered with the reading, masking the detection of perched water.

Since 1987, additional information pertaining to the geology beneath the IWD has been gathered (see Sections 2.4 through 2.8). This information shows that the area in the vicinity of the IWD is underlain by several basalt flows with a total thickness of approximately 85 feet. These flows are underlain by a red colored sedimentary interbed (red bed). This red bed is associated with, but is not the cause of perched water. The red bed is very porous, and acts as a water storage unit in which water accumulates. The basalt underlying the red bed is semi-impermeable in some locations, and is the layer which causes the formation of perched water bodies. The apparent thicknesses of the perched water bodies referenced above range from about four feet in well PS-1 to about 20 feet in wells PS-5 and PS-9. Neither the true thicknesses of the perched water bodies, nor their exact boundaries are known.



SCALE 1" = 675'

Figure 4-1 Gravimetric Survey Station Location Grid

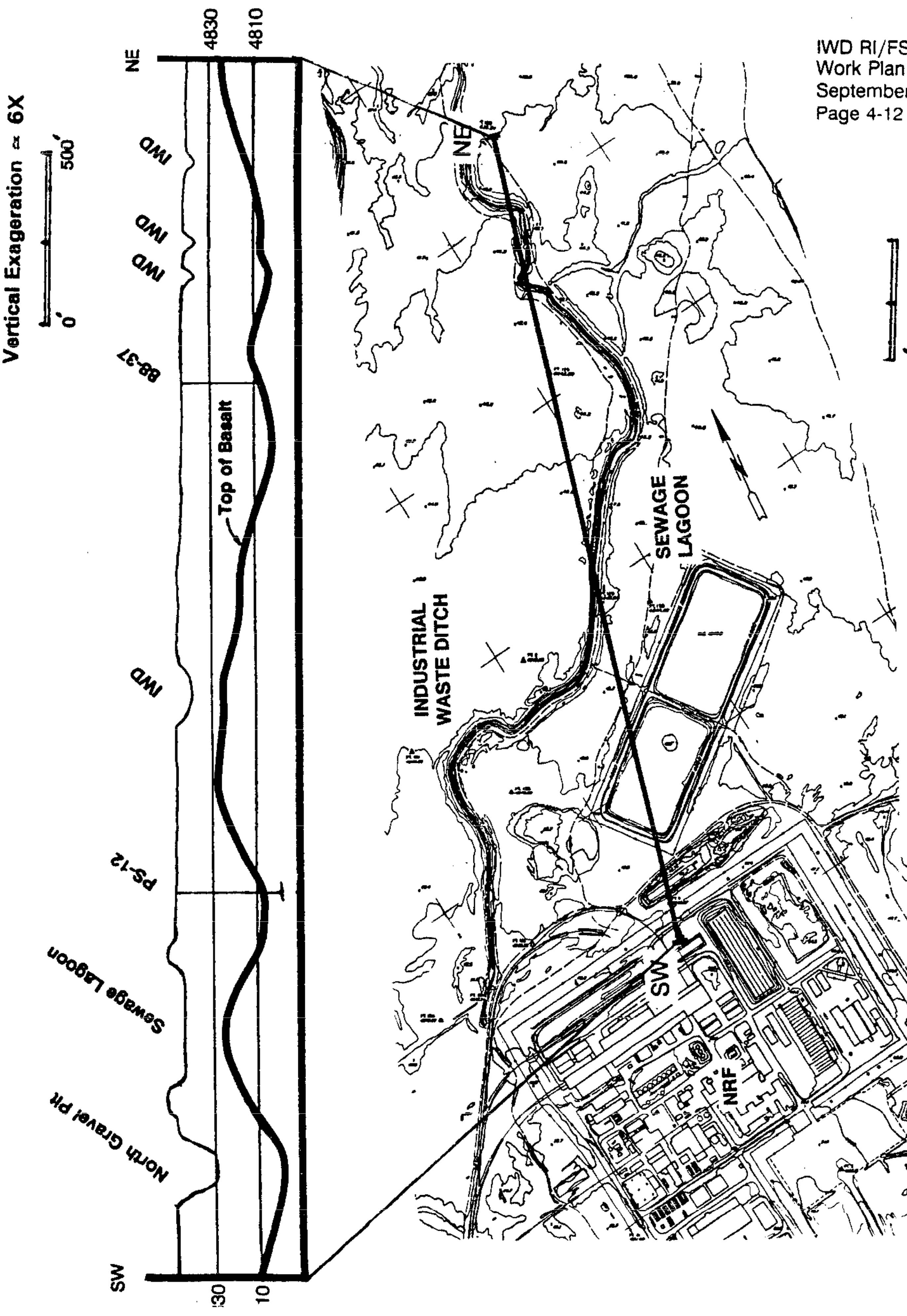


Figure 4-2 Cross S--ion - Top of Basalt

Although the 1987 resistivity study failed to identify the location of any perched water zones, the chances that the proposed resistivity study will be successful have increased because of the discovery of perched water during the 1991 drilling activities. A more detailed description of how the resistivity survey will be performed is presented in the Section 3.3.2 of the FSP and SOP-IO-14.

4.4.3 Geological and Hydrological Investigation

4.4.3.1 Alluvium Characterization

During wet periods, a large amount of water infiltrates into the subsurface through the gravels surrounding the IWD. It is important to know how this recharge interacts with water in the IWD. The surface of the basalt is often intrinsically impermeable, or fractures are filled with a thin layer of clay which causes basalt to act as though it were impermeable. Either situation promotes the perching of water. It is possible that the surface of the basalt may redirect the flow of water away from or towards the IWD.

In the past, water being discharged to the IWD contained low concentrations of heavy metals and other contaminants. Some of these contaminants were metabolized by algae and plants living in the IWD. Some of the contaminants were "locked" into the sediments of the IWD channel by the processes of adsorption, chelation, cation exchange, and anion exchange. Those contaminants not retained by the mechanisms described above migrated into deeper strata. The ability of these contaminants to migrate depends on many factors, including mineralogy, particle size, ambient temperature, soil moisture tension, pH, Eh, and activity of the ions involved (Fetter, 1988). Some contaminants migrate through subsurface gravels over greater distances, and at higher rates than other contaminants. This process of differential migration is expected to cause contaminants released into the subsurface from channel sediments and other sources to form zones around the bottom of the IWD channel as illustrated by Figure 4-3. Those contaminants which possess low migration potential will form a zone near the IWD channel, and those contaminants which possess a higher migration potential will form zones at increasing distances from the IWD.

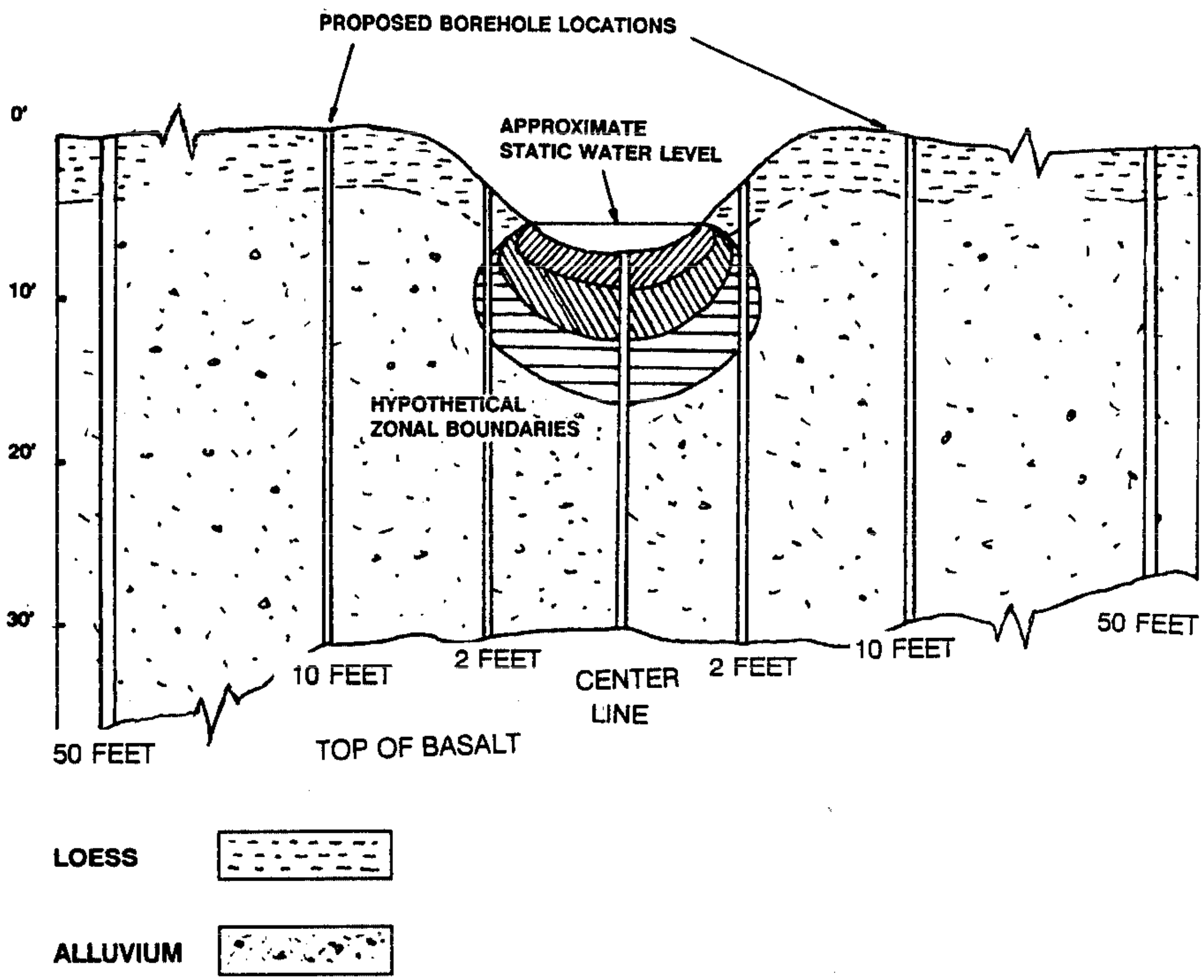


Figure 4-3 Zonation of Chemical Constituents

There are many factors which affect the mobility of metal ions in soil. These include valence of the ion, the ionic radius, and the physical characteristic of soil. The size of the potential contaminant zones cannot be determined until the physical properties of the soil beneath the IWD are determined. For this reason, a large number of samples will be required to assess the degree of zonation.

Four series of seven boreholes will be drilled in lines perpendicular to the IWD. The proposed locations of these lines have been selected based upon current hydrogeological information and to maximize the retrieval of information for comparison purposes.

One line will be placed at the outfall of the ditch. It is expected that the highest levels of contaminants will occur near the outfall. Data from the other lines can be compared to data from this line as a measure of the change in contaminant levels with distance from the outfall. One line will be placed between 1.2 and 1.8 miles from the outfall. This is the approximate distance at which year-round water ends in the IWD. Data from this line will be used for a beginning and end comparison. Beyond this point, potential contaminant levels are expected to decline rapidly because of the decreased volume of water which infiltrated through the IWD channel. One line will be placed near 0.6 miles from the outfall. This location correlates to the distance where the occurrence of algae ends. Uptake of heavy metal by algae is a significant process and could affect the concentrations of potential contaminants in the sediments. The last line will be placed at approximately 0.4 miles from the outfall. This location corresponds to a suspected high infiltration zone; the levels of contaminants at this location are anticipated to be higher than surrounding zones with lesser volumes of water infiltration. Additional lines may be placed at locations along the IWD channel which exhibit high infiltration rates; these are expected to overlie portions of the subsurface which exhibit high concentrations of contaminants.

Samples will be collected and analyzed for Total and TCLP Metals. Total Metals samples will be collected to assess the degree to which contamination is present in the subsurface. TCLP Metals analysis will be performed when certain 'trigger' levels are exceeded during the Total Metals analyses. The TCLP Metals analysis will be used in evaluating remedial action alternatives. Performing the TCLP analyses at this time will save money by minimizing the need for future borings.

Some of the samples to be analyzed for both Total and TCLP Metals will be prepared by sieving, and others will be prepared

Some of the samples to be analyzed for both Total and TCLP Metals will be prepared by sieving, and others will be prepared by rinsing with dilute nitric acid. It is anticipated that most contaminants will be bound to the finer portion of the alluvial sediments.

Analysis results of bulk samples would underestimate the concentration of contaminants contained in the fines of the sample. Sieving some samples prior to analysis will reduce or eliminate this bias in determining levels of contaminants. These results will then be compared to unsieved samples collected over the same zone to determine a more accurate measure of contaminant concentrations. Analysis of gravel rinsate will also be a measure of the assumption that most contaminants are in the finer portion of the alluvial sediments, and will add a third data point for a more accurate measure of contaminant concentrations in the alluvium. Performing this analysis at this time will save money by minimizing additional borings should significant contamination be found.

4.4.3.2 Perched Water Exploration

As a result of the 1991 drilling program, perched water was encountered at two locations, and a total of five piezometer wells were completed. A large amount of piezometric data has been collected from these wells; however, the lateral boundaries of these perched water bodies are not presently known. Similarly, the geological mechanisms which caused the perched water bodies to form are not fully understood, nor is it known whether these two water bodies are the only two which are present beneath the IWD.

The mechanisms which cause water to form perched bodies, and how these perched water bodies interact with recharge water, natural precipitation, and the IWD must be determined. The approximate size and the shape of these perched bodies must also be known. There are several reasons why the above information is important.

First, it is possible that these perched water bodies are irregular in shape, and that they possess "arms" which drain water away from the main body of perched water. It is not important to know exactly where the boundaries of perched water bodies lie, but it is important to know with a fair degree of certainty that water is not being directed away from the main perched water body.

Secondly, initial results of analyses of water samples collected from wells NRF-6 and NRF-6PS-6 show that levels of chromium are present at half of the MCL. Lack of good quality historical data prevents NRF from assuming that the present levels of chromium in these wells represent maximum historical or future levels. The quality of the perched water in the two identified locations cannot be assumed to be an accurate representation of the quality of all perched water that may be present beneath the IWD.

Finally, data on recharge is an essential input parameter for any potential ground water flow modeling. The two components of recharge that are of greatest concern are volume and location. To understand these parameters, the thickness and boundaries of the perched water bodies must be defined.

Up to five wells will be drilled to provide information on the perched water bodies. The exact location and number of wells will be determined based on the results of the resistivity measurements (see Section 4.4.2.2), and will be approved by IDHW and EPA. If perched water is encountered, a sample will be collected and analyzed for Total Metals and Organics before any well completion work is done. These samples will provide data of the effects that drilling the well had on perched ground water quality. When the well is completed and developed, another sample will be collected for Total Metals and Organics analysis. These samples will provide comparison information to the samples collected during drilling, and a more accurate portrayal of the true perched water quality.

4.4.3.3 Stream Infiltration Study

The IWD's ability to transport contaminants is determined by the volume of water flowing within the IWD channel. Increased flow into the IWD causes larger volumes of water to infiltrate through the bottom of the IWD. The highest probability for the occurrence of significant levels of contaminants occurs at these high infiltration locations. High infiltration zones are also zones of high recharge to the underlying perched water bodies and the regional aquifer. Recharge is an essential input parameter for any ground water flow model.

To determine the location of high infiltration zones, an infiltration study will be performed. An infiltration study of similar nature was performed in 1988. During this study, measurements were taken at nine locations. The results of the infiltration study showed an increase in flow volume in the IWD over the first 0.4 miles. Over the next 0.6 miles, the stream flow volume decreased. At a distance of 1.35 miles from the outfall, the flow volume increased to a maximum, then declined again. This type of behavior is inconsistent with expected geologic norms, and supports the conclusion that the data from the infiltration study are in error.

To predict the stress on the ground water system caused by recharge, a water budget for the IWD must be determined. The volume of water entering the IWD must be measured. Water that enters the IWD from NRF comes through one 48" culvert. The volume of discharge from this culvert varies depending on the weather, time of day, and prototype plant operation levels. A flume will be constructed to measure the volume of water entering the IWD over an extended period.

4.4.4 Geochemical Analyses

Perched water found in NRF wells PS-1, PS-5, PS-6, PS-7 and PS-9, water from the sewage lagoons and the sewage lagoon piezometer well, and water from the IWD will be sampled. Results from the analyses of these samples will be compared with each other to determine the source of water present in the NRF-6PS-1, PS-5, PS-6, PS-7, and PS-9 wells. Data gathered from the analyses of the water will provide valuable information about the hydrogeologic characteristics of the lithology beneath the IWD. This information will also provide data on the geochemical properties of the strata beneath the IWD, and will aid in determining the effect that precipitation has on the geochemistry of the perched water bodies. Analyses of the perched water will determine if contamination is present, and provide input data for potential hydrogeologic modeling work. Section 3.9 of the FSP discusses the specific parameters which will be tested. Analysis results of previous water sampling is presented in Section 2.8.5 of the Work Plan.

The sample locations along the IWD correspond to areas of the IWD channel with the highest potential of being a source of water to the perched water bodies located beneath wells NRF-6PS-1, PS-5, PS-6 and PS-7 (See Figure 4-4). This sampling program assumes that there are segments along the IWD which allow water to infiltrate at a higher rate than other segments. The locations of these high infiltration zones are unknown, if they exist at all. Data collected while drilling wells PS-1 through PS-15 during the summer of 1991 indicates that the perched water bodies beneath the IWD cover an area of approximately 100 by 100 yards. The spacing between sample location along the IWD is based on these observations.

Several pairs of duplicate samples will be collected from the piezometer wells. One sample will be filtered and the other one not. This will be done to determine to what extent the suspended sediment portion of the sample adds to the overall level of contamination. Refer to

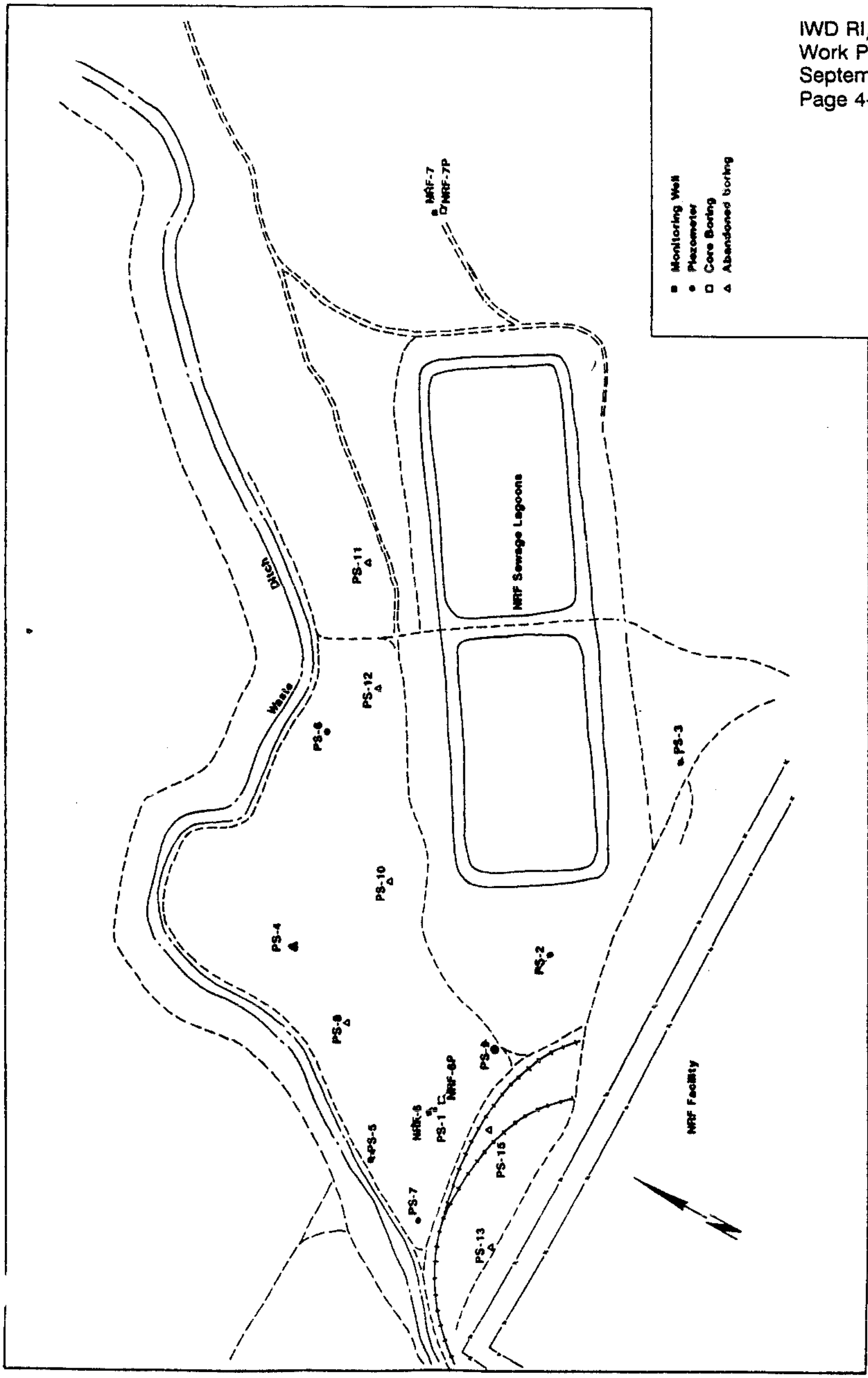


Figure 4-4 Well Location Map

Section 3.9 of the FSP for more details of the specific analyses to be performed, their location and timing.

4.4.5 Hydrogeological Modeling

Although existing data does not indicate the need for a detailed hydrogeologic modeling effort at this time, data collected during the RI/FS process may identify additional data gaps or specific informational needs (such as fate and transport assessment) that can be provided by hydrogeologic modeling. If this situation occurs, NRF will define the objectives of the modeling work such that the identified data gaps and information needs are satisfied.

This section has been included in the Work Plan in anticipation of future potential modeling efforts. NRF will continue working with the EPA and IDHW to assess the needs for hydrogeologic modeling. The decision to model and the model selection criteria will be made by NRF with review by EPA and IDHW.

Sections 4.4.5.1 through 4.4.5.6 provide a description of the information required for an effective hydrogeologic modeling effort. These sections also include a discussion of those data that will be collected during the RI/FS that will be used to support the modeling effort should it become necessary. The conceptual physical hydrogeologic model that has been developed for the IWD is discussed in Section 2.2.3.9. This conceptual model will be used to approximate and simplify the highly complex geology found beneath NRF. Any modeling performed as part of this RI/FS will also be used in the completion of the NRF site comprehensive RI/FS.

4.4.5.1 Recharge

The NRF IWD has been in operation for over 30 years, and has been the primary discharge site for non-sewage liquid industrial waste. Discharge to the IWD ranges from 150 to 300 gallons per minute (gpm), or approximately 120 million gallons annually. Since the IWD, for the most part, is built on an alluvial plain which exhibits widely varying degrees of permeability depending on location; and since in some locations, the IWD directly overlies highly permeable basalt, infiltration rates through the IWD channel probably vary greatly. As discussed in Section 4.4.3.3, an infiltration study will be performed as part of the RI/FS. This study will identify locations along the IWD which exhibit high infiltration rates.

In addition to the IWD, the sewage lagoon is also an aquifer recharge source that will be considered. NRF discharges its sewage and a small amount of storm water into evaporative sewage lagoons located northeast of the site. One lagoon is full all year, and the other lagoon is used for overflow in the spring and early summer. An estimated 12 to 13 million gallons of water infiltrate through the bottom of the sewage lagoons annually. This estimate is based on current discharge rates and estimates of evaporation rates.

In addition to recharge from the IWD and the sewage lagoons, infiltration from precipitation is also a source of recharge to the aquifer. NRF lies on the north central edge of the eastern Snake River Plain (SRP). The SRP possesses a semi-arid climate with NRF receiving approximately 8.4 inches of precipitation annually. Warm temperatures, and short duration, low volume precipitation events minimize the amount of moisture infiltrating through the surface, and eventually reaching the Snake River Plain Aquifer (SRPA) between the months of June and September. However, occasional heavy precipitation and snow melt in the spring also contribute to aquifer recharge.

4.4.5.2 Discharge

Water leaves the SRPA from several sources. At NRF, water is extracted through four production wells. This water is used for plant cooling water, drinking water, and other domestic and industrial uses. A large amount of water extracted by the wells is returned to the aquifer via the IWD and the sewage lagoons. Only water which evaporates or transpires prior to infiltration (including evaporation through the cooling towers), or that which is consumed is not returned to the aquifer.

Evaporation rates for NRF have been estimated to be between 36 and 40 inches per year. Transpiration accounts for an additional 6 to 9 inches per year. Estimates for evaporation may be high because these figures assume a fully and constantly saturated surface. These figures suggest that approximately 2.1 million gallons of water are lost through evapotranspiration from the IWD annually.

4.4.5.3 Top of Basalt Contours

As part of the hydrogeologic investigation, a contour map of the top of basalt in the vicinity of the IWD will be constructed. Elevation points on top of the basalt will be estimated using gravimetric data. The interpretation of the gravimetric data will be confirmed by 25 boreholes drilled to the top of basalt. Additional discussion of the gravimetric survey and the 25 alluvium boreholes is contained in sections 4.4.2.1 and 4.4.3.1. It is important to characterize the top of basalt for several reasons. During past investigations, perched water has been found to occur at the basalt/alluvium interface beneath areas of high recharge. If the surface of the basalt is inclined at that location, the water will run downhill and collect in topographically low portions of the basalt. This situation provides recharge to the aquifer at a location different from what would be expected, assuming only vertical migration. Knowing the contours of the top of basalt will provide insight into the possible interactions between natural and man-induced infiltration. Since recharge is an important input for computer models, as much data as practical must be obtained.

4.4.5.4 Piezometric Data

NRF is currently collecting water level data from approximately 14 nearby wells. These data have been compiled by NRF through 1991, and head distribution and flow direction maps have been constructed (Section 2.2.3.7). These maps show that water flow direction in the vicinity of NRF have changed over time. In general, water in the SRPA flows from northeast to southwest, but locally, the flow direction varies in response to local and regional recharge events.

4.4.5.5 Water Level Monitoring in Piezometer Wells

Digital water level data loggers along with pressure transducers have been installed in NRF wells PS-1, PS-5, PS-6, PS-7 and PS-9. These data loggers will be used to collect long term water level data from the shallow piezometer wells drilled during the summer of 1991. The information collected by these data loggers will be used to interpret the effects that seasonal variations in precipitation have on the perched water bodies. These data will also be used to determine whether the water observed in the various wells is hydraulically connected, and will be used as input into the hydrogeologic model.

At present two 'apparent' perched water zones are known to be present beneath the IWD. One zone is located beneath wells NRF-6PS-1, 5, 7, and 9 and the other is located beneath NRF-6PS-6. These zones are termed 'apparent' because it is not really known if water present in the various wells is from one perched water zone or several. It is not known if the two zones are actually one large zone. The collection of water level data from all the perched water wells will show how water levels in the various wells change over time for a given recharge event. A well-to-well comparison of the response to these events will be an indication of the degree of interconnection between the wells. This knowledge will then be used in making a general site-wide hydrogeologic interpretation.

4.4.5.6 Other Modeling Input Parameters

Some of the input parameters have been discussed above, and will be collected during the RI/FS. The remaining input parameters will be obtained from literature, or have already been obtained. Additional input data may be required should modeling be done. These data may include general input values, such as vertical and horizontal conductivity, beginning head distribution, physical dimensions, and boundary conditions. Cell dimensions and layer thickness will be based on observation, and boundary conditions will be assumed to be a combination of constant head boundaries and no-flow boundaries. Additional data, referred to as sources and sinks, may be required. Sources would include water infiltration from the IWD, sewage lagoons, precipitation and other sources. Sinks include water extracted by the production wells and evapotranspiration.

Other potential input parameters are listed below. Many of these values will be obtained from sources other than from actual field measurements. These parameters are marked with an asterisk.

Length of Source Parallel to Ground Water Flow
Width of Source Perpendicular to Ground Water Flow
Thickness of Source Zone
Infiltration Rate*
Volumetric Moisture Content in Contaminant Zone*
Volumetric Moisture Content in Unsaturated Zone*
Bulk Density in Contaminant Zone*
Sorption Coefficient in Contaminant Zone*
Bulk Density in Unsaturated Zone*
Sorption Coefficient in Unsaturated Zone*
Half Life of Contaminant*
Initial Mass of Source Volume
Molecular Weight of Contaminant
Contaminant Solubility Limit
Bulk Density in Saturated Zone*
Porosity of Saturated Zone*
Sorption Coefficient in Saturated Zone*
Longitudinal Dispersivity*
Transverse Dispersivity*
Saturated Pore Velocity*
Well Screen Mixing Thickness
Thickness of Unsaturated Zone
Receptor Data

5.0 REMEDIAL INVESTIGATION/FEASIBILITY STUDY TASKS

5.1 Project Objectives

The purpose of the RI/FS is to gather sufficient information to quantify the risk to public health and the environment (Baseline Risk Assessment), and to develop and evaluate viable remedial alternatives (Feasibility Study) at the IWD. The objective of the RI is to determine the nature and extent of contamination at the site in order to support the activities of the FS. The objective of the FS is to develop and evaluate appropriate remedial action alternatives based on the RI data.

5.2 Project Scope

NRF and contractor personnel will utilize an integrated and phased approach for the RI/FS. In this approach, the RI and FS will be conducted concurrently, with data collected in the RI influencing the development of remedial alternatives in the FS, which in turn will affect the data needs and scope of additional phases of field investigations. During the RI, data collection will be conducted in phases, with the results of the Baseline Risk Assessment being a determining factor in decisions regarding the necessity for additional phases of investigation. The Phase I investigation will integrate existing data with information that will be gathered through direct field investigations of the sediment and dredge piles, targeted samples, and geophysical, geotechnical and hydrogeologic data. The scope of this investigation includes:

- Sediment and Dredge Pile Samples:

  These samples will be collected in a systematic pattern to establish the contaminant levels in the sediments and dredge piles to use in the Risk Assessment calculations.

- Targeted Sampling and Existing Data Evaluation:

  This effort will determine the useability of existing data.

- Geophysical, Geotechnical, and Hydrogeologic Data:

  This data will be used in assessing fate and transport of the contaminants to the ground water.

5.3 Phase I Field Investigation

The Phase I field investigation is divided into two parts: Near Surface and Sediment Sampling Plan; and the Hydrogeological Sampling Plan. Samples will be analyzed for Target Compound List (TCL) VOCs and SVOCs, Total Petroleum Hydrocarbons (TPH) and/or selected Total Metals. Sediment and soil samples will also be analyzed for CEC, Atterberg limits, percent moisture, and grain size distribution to determine soil physical parameters and their effect on contamination migration. Selected samples may also be analyzed by the Toxicity Characteristic Leaching Procedure (TCLP) for metals if, Total Metal concentrations are greater than twenty times the TCLP limit. Soil pH tests may be conducted on samples using field investigation instruments.

Data from the Phase I investigation will be qualitatively and statistically evaluated in conjunction with existing data to determine whether a Phase II investigation is necessary. The rationale and scope of any Phase II investigation will be discussed with and approved by the EPA, IDHW, and IBO project managers prior to implementation.

5.3.1 Surface and Sediment Sampling Plan

The following tasks comprise the Near Surface and Sediment Field Sampling Plan:

- Surface soil (0 to 12 inches) sampling for verification and site characterization along the IWD

- Laboratory analysis of geotechnical characteristics of the sediments, soils, and bedrock materials

5.3.2 Dredge Pile Sampling

The following tasks comprise the dredge pile sampling:

- Collect surface samples

- Collect samples in the middle of the dredge piles

- Collect samples in undisturbed soil beneath the dredge piles

- Analysis of samples by the contract laboratory

5.3.3 Background Sampling

The following tasks comprise the background sampling plan.

- Identify and sample 20 background locations

- Collect samples for metals at all sample locations

- Collect TPH and SVOC samples at five of the 20 locations

5.3.4 Hydrogeological Sampling Plan

The following tasks comprise the Hydrogeological Sampling Plan:

- Geophysical Investigation
  Gravimetric Survey (with associated boreholes)

- Resistivity Survey

- Alluvium Characterization

- Surface Samples
  Permeability, redox, pH, buffering capacity (BC), Cation Exchange Capacity (CEC), Soluble Ion Exchange Capacity (SIEC), Distribution Coefficient (K_d), clay mineralogy, particle size distribution

- Deep Samples
  pH, CEC, particle size distribution, organics, and metals distribution

- Perched Water Investigation
  Construct shallow wells
  Conduct pump tests on wet perched water wells (new wells)
  Sample perched water wells (new wells)
  Perform perched water slug tests (existing wells)
  Perform IWD infiltration study
  Measure process discharges to IWD

- Level measurements of perched water

- Geochemical Sampling of Perched Water, IWD, and Sewage Lagoons
  Anions, cations, nutrients, organics, and metals

5.4 Potential Phase II Field Investigation

If Phase I data suggests that sufficient site characterization information has been collected, NRF and their contractor will proceed with the risk assessment for the site. An RI report, presenting the Phase I data and recommendations of the risk assessment, will be prepared. After a review of the RI report, the need for implementing a Phase II investigation will be evaluated in light of the data requirements for the feasibility study. The RI report will be incorporated into the RI/FS report upon completion of the FS report.

Potential Phase II work may include:

- Additional soil/sediment sampling

- Installation of additional monitoring wells and an additional ground water investigation

- Treatability studies or pilot testing

6.0 PROJECT MANAGEMENT

6.1 Project Organization and Responsibilities

This section provides the proposed organizational structure for completion of the RI/FS work. This structure involves the use of Westinghouse Electric Corporation's NRF personnel for project management. A subcontractor will be hired by NRF to complete the actual investigative steps of the RI/FS. Figure 6-1 provides an organizational chart. EPA, IDHW, and DOE Project Management roles and responsibilities are presented in Section 4.0 of the FFA/CO action plan.

6.1.1 Position Descriptions

6.1.1.1 Idaho Branch Office

- IBO Remediation Project Manager, R. D. E. Newbry

The IBO Remediation Project Manager (RPM) shall oversee the implementation of the FFA/CO for IBO. All communications with the EPA and IDHW, including documents, reports, approvals, and other correspondence concerning the RI/FS, shall be directed through the IBO RPM. The IBO RPM is also the DOE RPM for all remediation work at NRF.

6.1.1.2 Westinghouse Electric Corporation - NRF

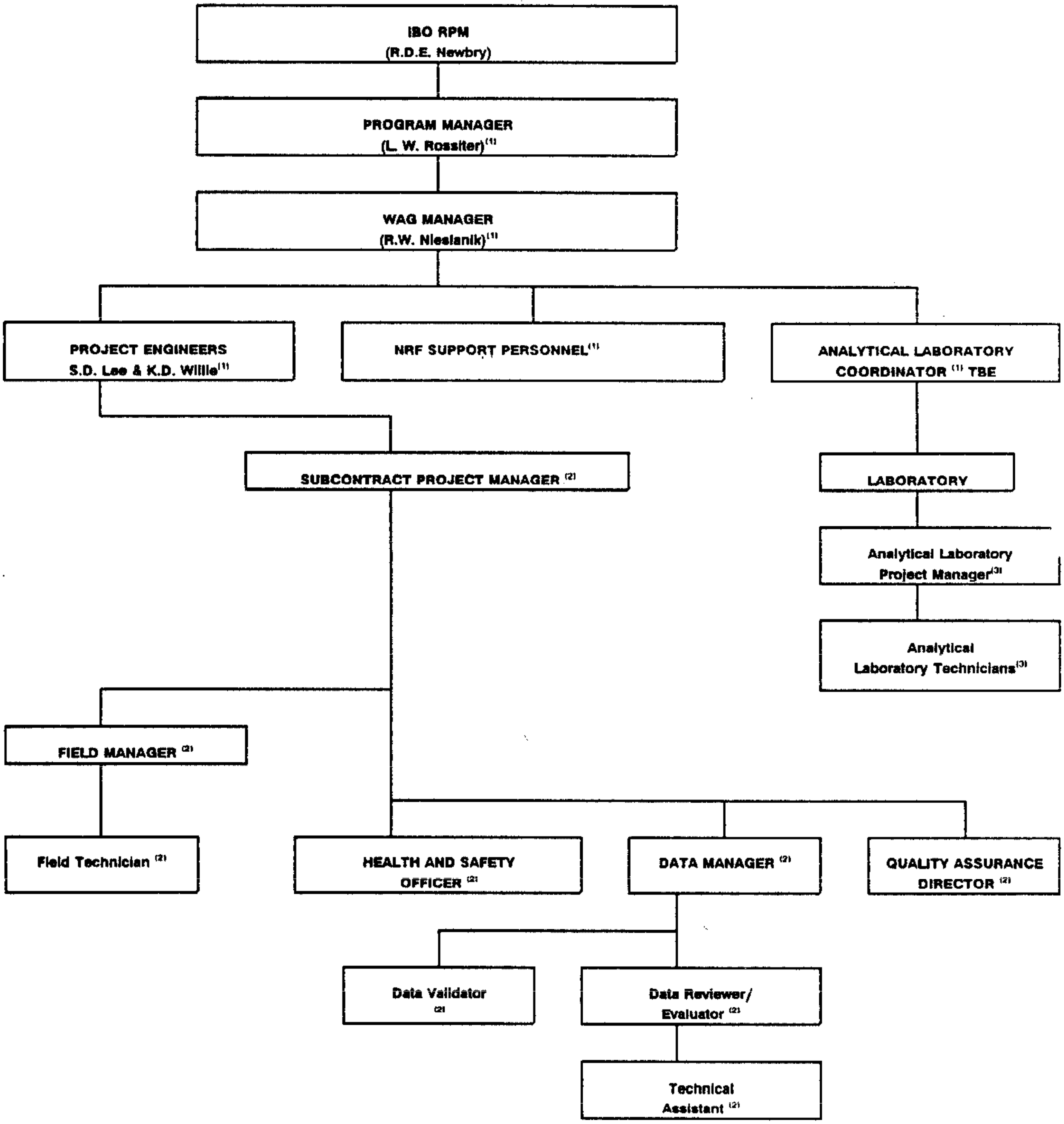
- NRF Program Manager, L. W. Rossiter

The NRF Program Manager has overall responsibility for assuring that the project meets objectives and quality standards. In addition, he is responsible for technical quality control and project oversight, and will provide the WAG Manager with access to corporate resources.

- WAG Manager, R. W. Nieslanik

The WAG Manager directs and supervises the various RI/FS component activities for the NRF. Included in this responsibility is the monitoring of RI/FS progress, review and approval of all submittals to the RPM, and the approval of the scheduling and budgeting of RI/FS activities. The WAG Manager performs the important function of arbitrator of differences between the Project Quality Assurance Director and the Project Engineer.

Figure 6-1 Organizational Chart for Conducting the IWD RI/FS



(1) Westinghouse Electric Corporation Personnel
(2) Field Subcontracted Personnel
(3) Analytical Laboratory Subcontractor Personnel

TBE - To be established

- Project Engineers, S. D. Lee and K. D. Willie

The Project Engineers (PE) for NRF shall manage daily RI/FS field activities. The Project Engineers' responsibilities include the management of RI/FS schedules, and the review and approval of submittals to the WAG Manager. The Project Engineers are responsible for assuring that information and data necessary for quality assurance evaluations are provided to the Project Quality Assurance Director. The PEs will oversee the major subcontract issues to complete the actual investigation and evaluation steps of the RI/FS. The PEs are also responsible for assuring implementation of project internal and external audit corrective actions. The PEs will also supervise drilling and well installation, ground water testing, and logging of all borings. Other activities and responsibilities associated with data QA/QC of the PEs are listed in Section 2 of QAPjP (Appendix B).

- Analytical Laboratory Coordinator

The Analytical Laboratory Coordinator shall be the direct interface with the analytical laboratory. The Analytical Laboratory Coordinator responsibilities shall include coordination of the subcontract with the laboratory, coordination of sample shipments, coordination of receipt of completed data packages, and resolution of corrective actions noted with respect to analytical laboratory operations.

- NRF Support Personnel

The NRF Support Personnel shall report to the Project Engineers. These individuals will perform daily work efforts as necessary and follow the RI/FS subcontractor activities. In addition, these individuals will identify and resolve operational problems associated with this investigation.

6.1.1.3 Subcontractor Personnel

- Subcontractor Project Manager

The Subcontractor Project Manager (SPM) shall be the main contact between the subcontractor and NRF. The SPM shall direct all activities of the subcontractor personnel. The SPM shall assure all RI/FS work tasks are completed and schedules maintained.

- Quality Assurance Director, Subcontractor Employee

The Quality Assurance Director, Subcontractor employee (QADS) shall report directly to the Subcontractor Project

Manager, and shall maintain an independent management status equivalent to that of the Field Manager. The QADS primary responsibilities are to perform audits of all RI/FS activities for total quality, and identify those practices which are not in compliance or consistent with the standard of total quality represented by the QAPjP for corrective action.

- Data Manager

The Data Manager is responsible for managing all RI/FS data activities including data validation, review, and evaluation. The Data Manager is also responsible for implementation of data management audit corrective actions. The Data Manager is responsible for providing reports describing analytical quality control problems associated with data validation and review which are encountered, and the corrective actions taken. The Data Manager will work with the NRF PEs to manage the interface with the subcontracted Analytical Laboratories.

- Field Manager

The Field Manager is responsible for all field activities associated with the RI/FS including, but not limited to, the collection of surface water, ground water, well water, sediment, and soil samples. The Field Manager is also responsible for the accuracy of all field-related documentation including field log books, driller's logbooks, sample labels, and Chain-of-Custody records.

- Health and Safety Officer

The Health and Safety Officer shall implement the RI/FS Health and Safety Plan, identify deviations from anticipated conditions described in the plan to the Field Manager for corrective action, and authorize the cessation of work, if necessary. The Health and Safety Officer shall assure that health and safety monitoring equipment is operating properly and confirm that subcontractor personnel working on-site have the proper medical surveillance program and health and safety training. The Health and Safety Officer shall perform internal health and safety audits.

- Data Validator

The Data Validator is responsible for review and validation of all analytical data submitted by the analytical laboratory. The Data Validator shall review data packages to assure compliance with the standards of accuracy, precision, and completeness specified in the QAPjP.

- Data Reviewer/Evaluator

The Data Reviewer/Evaluator shall review and evaluate all validated data. This includes the identification of sample results outside the normal range, the identification of adverse data trends, and comparison of data to applicable standards. The Data Reviewer/Evaluator is also responsible for directing the Technical Assistant in the incorporation of data into the project data management system.

- Field Technicians

The Field Technicians shall be responsible for all environmental (water, soil, sediment, air, etc.) samples collected as part of the RI/FS. The Field Technicians will also be responsible for the calibration and maintenance of all field sampling equipment, including equipment decontamination.

- Technical Assistant

The Technical Assistant shall be responsible for setting up the database system, inputting the validated data, and providing data output in the formats required for various RI/FS evaluations and documentation.

6.1.2 Project Personnel Responsibilities

All Project Personnel involved with the RI/FS are responsible for:

- Complying with the requirements of the QAPjP

- Identifying to the QAD, PE, or WAG Manager any special quality assurance problems which they cannot appropriately address to their immediate supervisor.

6.1.3 Multiple Positions

A qualified person may be used to fill more than one position if, in the opinion of the WAG Manager, this would not impact the quality or schedule of the work, and requisite independence is not compromised. Individuals who fill more than one position must be qualified for all work they are to perform.

6.1.4 Analytical Laboratory

Most of the analytical laboratory services will be provided by Wadsworth Alert Laboratory in North Canton, Ohio. The QA Program Plan for this laboratory is provided in Appendix D. The coordination of technical issues between NRF and the analytical laboratory will be handled by the Analytical Laboratory Coordinator (ALC) and contractual issues will be handled by NRF Purchasing. The responsibilities of key laboratory personnel are provided in the Section 2 of the QAPjP (Appendix B) and laboratory QAPP (Appendix D).

Chen Northern Inc., Billings, Montana, has been subcontracted to perform the laboratory work associated with the geochemical analyses discussed in the hydrogeological investigation (see Appendix D).

In addition to the analytical laboratories, a subcontract has been placed with Daniel B. Stephens and Associates to perform the physical property analysis work identified in the FSP (Appendix B). This laboratory subcontract was placed through the Field Subcontractor and approved by NRF. The physical properties laboratory has submitted a Quality Assurance Program Plan for NRF review and incorporation into the Project Files.

6.2 Project Coordination

The WAG Manager is the primary point of coordination for the project. Communications between the Field Subcontractor, the Subcontract Laboratories, and the RPMs go through the WAG Manager. The FFA/CO states that a monthly report is required to update the RPMs on the status of all work under the FFA/CO. The monthly report for the IWD RI/FS and all remediation work at NRF will be issued as part of the INEL monthly report. No separate routine status reports will be issued by NRF. All correspondence between NRF and the RPMs will go from the WAG Manager to the IBO RPM, and then to the EPA and IDHW RPMs.

All coordination between the subcontractors and NRF will be through the Project Engineers and then to the WAG Manager. NRF Purchasing will be kept informed of all discussions between the subcontractors and NRF.

Communications between all parties will be documented with either memoranda to file, telephone conference reports, or formal letters. These communication documents will be placed in the Project File. Those documents that affect the remediation decision will also be placed in the Administrative Record. The DMP (Appendix B, Part C), the FFA/CO, and Guidance for Conducting RI/FSs Under CERCLA will be consulted to determine what documents should be placed in the Administrative Record.

6.3 Schedules

Figure 6-2 provides the detailed schedule for this project. This schedule provides both a baseline schedule to meet the requirements of the FFA/CO, and a working schedule which has been developed to accelerate the completion of this RI/FS. The working schedule is based on sample collection as described in the FSP (Appendix B, Part A) during the 1992 field sampling season. It is intended that all data necessary to complete this RI/FS will be collected at this time. However, the baseline or FFA/CO schedule provides for some additional follow-up sampling in the spring of 1993. This effort will take place only if significant data gaps are identified during the evaluation of the data collected in 1992. Every effort will be made to ensure that adequate data is collected in 1992 so that the accelerated working schedule can be met. The following is a brief description of the major elements of the schedule.

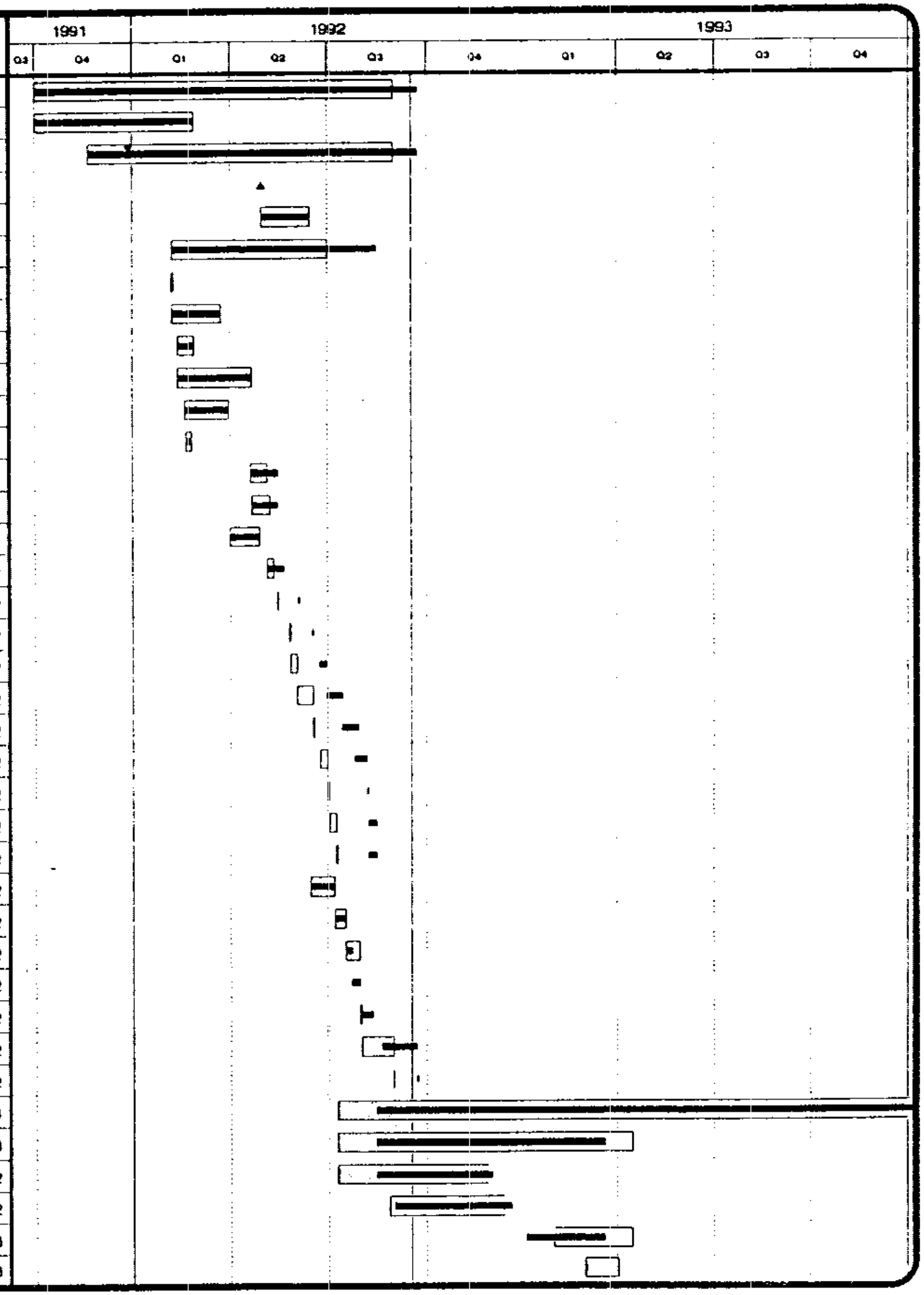
6.3.1 Remedial Investigation

NRF's procurement actions will lead to a September 1992 start of the RI work. This work is preparatory to the FS during which the alternatives identified during the RI are reviewed. The RI is composed of the following tasks:

- Collection of field data
- Evaluation of data
- Preparation of Baseline Risk Assessment
- Writing the RI report
- Review by Environmental Remediation
- Review by IBO
- Review by the EPA and IDHW

The collection of field data is scheduled for September through November 1992. This involves drilling and boring for approximately 41 days with a total footage of approximately 3,200 feet. Samples from the drilling and boring will be shipped to a subcontractor analytical laboratory for analysis. The results of the lab analysis will be used as a basis for evaluation and preparation of the baseline risk assessment.

Task Name	Start Date	End Date
RI/FS SCOPING PROGRESS	1-Oct-91	22-Sep-92
SCOPE OF WORK (SOW)	1-Oct-91	27-Feb-92
WRITE DRAFT WORK PLAN (WP)	20-Nov-91	22-Sep-92
SUBMIT DRAFT WP TO EPA/IDHW	30-Apr-92	30-Apr-92
EPA/IDHW REVIEW OF WP	30-Apr-92	13-Jun-92
PROCUREMENT ACTIONS	7-Feb-92	15-Aug-92
SUBMIT 580&DRAFT SPEC TO PUR	7-Feb-92	7-Feb-92
WAGE DETERMINATION REQUESTED	7-Feb-92	22-Mar-92
DRAFT SPEC PREPARATION	12-Feb-92	27-Feb-92
FINAL SPEC PREPARATION	12-Feb-92	20-Apr-92
PREPARE COST ESTIMATE	19-Feb-92	30-Mar-92
BIDDER LIST PREPARED	20-Feb-92	25-Feb-92
IBO TECH APPROVAL	20-Apr-92	15-May-92
SPEC REVIEW & 351 SIGN-OFF	21-Apr-92	14-May-92
SOLICIT CBD	1-Apr-92	27-Apr-92
ISSUE INQUIRY	5-May-92	20-May-92
PRE-BID CONFERENCE	3-Jun-92	3-Jun-92
BIDS RECEIVED	16-Jun-92	16-Jun-92
EVALUATION OF BIDS	23-Jun-92	29-Jun-92
PLACEMENT PUR APPROV LETTER	30-Jun-92	13-Jul-92
PO PLACEMENT	14-Jul-92	29-Jul-92
PO ACKNOWLEDGEMENT BY VENDOR	27-Jul-92	7-Aug-92
PRE-EVOLUTION BRIEFING	8-Aug-92	8-Aug-92
VENDOR MOBILIZATION	9-Aug-92	15-Aug-92
ACCEPTANCE OF SAFETY PLAN	9-Aug-92	15-Aug-92
WRITE FINAL WP	14-Jun-92	6-Jul-92
INTERNAL REVIEW OF WP	7-Jul-92	16-Jul-92
IBO REVIEW&COMMENT OF FINAL WP	17-Jul-92	23-Jul-92
INCORPORATE COMMENTS	24-Jul-92	30-Jul-92
SUBMIT FINAL WP TO EPA/IDHW	31-Jul-92	11-Aug-92
EPA/IDHW REVIEW OF WP	21-Aug-92	21-Sep-92
FINAL WP ACCEPTED	22-Sep-92	22-Sep-92
RI/FS IMPLEMENTATION	16-Aug-92	30-Jan-94
REMEDIAL INVESTIGATION (RI)	16-Aug-92	19-Mar-93
COLLECT FIELD DATA	16-Aug-92	2-Dec-92
EVALUATE DATA	2-Sep-92	19-Dec-92
PREPARE BASELINE RISK ASSESSME	4-Jan-93	19-Mar-93
COLLECT FOLLOW-UP DATA	1-Mar-93	1-Mar-93



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e 6-2 Project Schedule

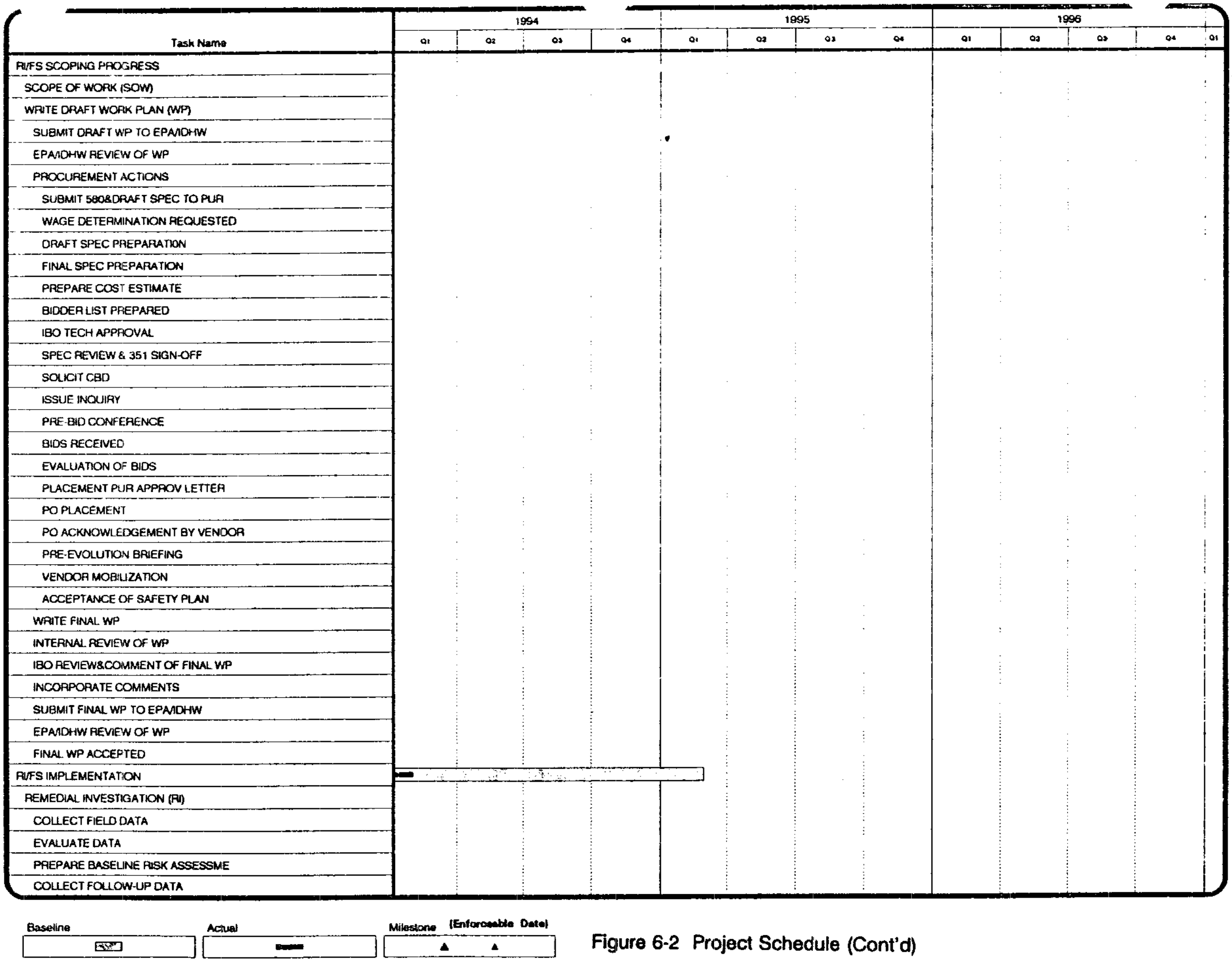

Figure 6-2 Project Schedule (Cont'd)

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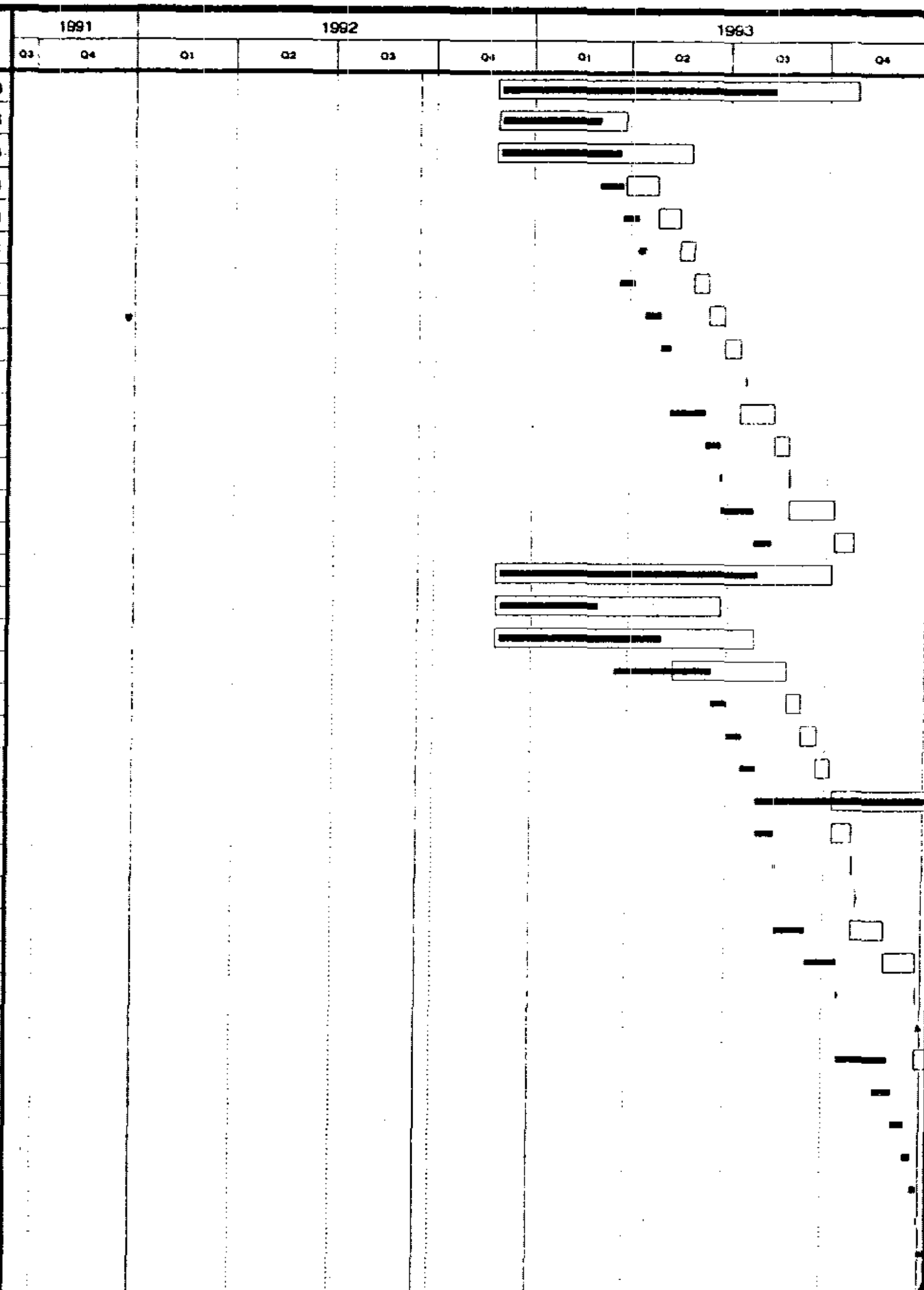
Task Name	Start Date	End Date
RI REPORT	2-Dec-92	10-Aug-93
SUBCONTRACTOR PREPARE REPORT	3-Dec-92	2-Mar-93
NRF WRITES HYDROGEOL PORTION	2-Dec-92	21-Mar-93
NRF REVIEW	3-Mar-93	23-Mar-93
SUBCONT INCORPORATES COMMENTS	24-Mar-93	7-Apr-93
NRF INCORP SUB REPORT INTO RI	8-Apr-93	14-Apr-93
INTERNAL NRF REVIEW	22-Mar-93	4-Apr-93
BETTIS REVIEW	15-Apr-93	28-Apr-93
INCORP BETTIS COMMENTS	29-Apr-93	8-May-93
RI REPORT DUE TO IBO	17-Jul-93	17-Jul-93
IBO REVIEW & COMMENTS	9-May-93	9-Jun-93
INCORP IBO COMMENTS	10-Jun-93	23-Jun-93
SUBMIT DRAFT RI REPORT W/RA	24-Jun-93	24-Jun-93
EPA/IDHW REVIEW	25-Jun-93	24-Jul-93
INCORP EPA/IDHW COMMENTS	25-Jul-93	10-Aug-93
FEASIBILITY STUDIES (FS)	3-Dec-92	28-Jul-93
CONDUCT INITIAL SCREEN OF ALT	3-Dec-92	2-Mar-93
CONDUCT FS	3-Dec-92	1-May-93
WRITE DRAFT FS REPORT	19-Mar-93	16-Jun-93
INTERNAL REVIEW OF FS REPORT	17-Jun-93	30-Jun-93
BETTIS REVIEW OF FS REPORT	1-Jul-93	14-Jul-93
INCORP BETTIS COMMENTS ON FS R	15-Jul-93	28-Jul-93
RI/FS REPORT	29-Jul-93	30-Jan-94
COMBINE RI & FS REPORTS	29-Jul-93	14-Aug-93
SUBMIT DRAFT RI/FS RPT TO IBO	15-Aug-93	15-Aug-93
DATE DRAFT RI/FS DUE TO IBO	31-Oct-93	31-Oct-93
IBO REVIEW & COMMENT	16-Aug-93	14-Sep-93
INCORP IBO COMMENTS	15-Sep-93	14-Oct-93
SUBMIT DRAFT RI/FS TO EPA/IDHW	15-Oct-93	15-Oct-93
DATE DRAFT RI/FS REPORT DUE	31-Dec-93	31-Dec-93
EPA/IDHW REVIEW	16-Oct-93	29-Nov-93
WRITE FINAL RI/FS REPORT	18-Nov-93	3-Dec-93
INTERNAL REVIEW	4-Dec-93	15-Dec-93
IBO REVIEW & COMMENT	16-Dec-93	22-Dec-93
INCORP IBO COMMENTS	23-Dec-93	29-Dec-93
SUBMIT FINAL RI/FS REPORT	30-Dec-93	30-Dec-93
EPA/IDHW REVIEW	31-Dec-93	29-Jan-94
FINAL RI/FS REPORT ACCEPTED	30-Jan-94	30-Jan-94



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Fi ;-2 Project Schedule (Cont'd)

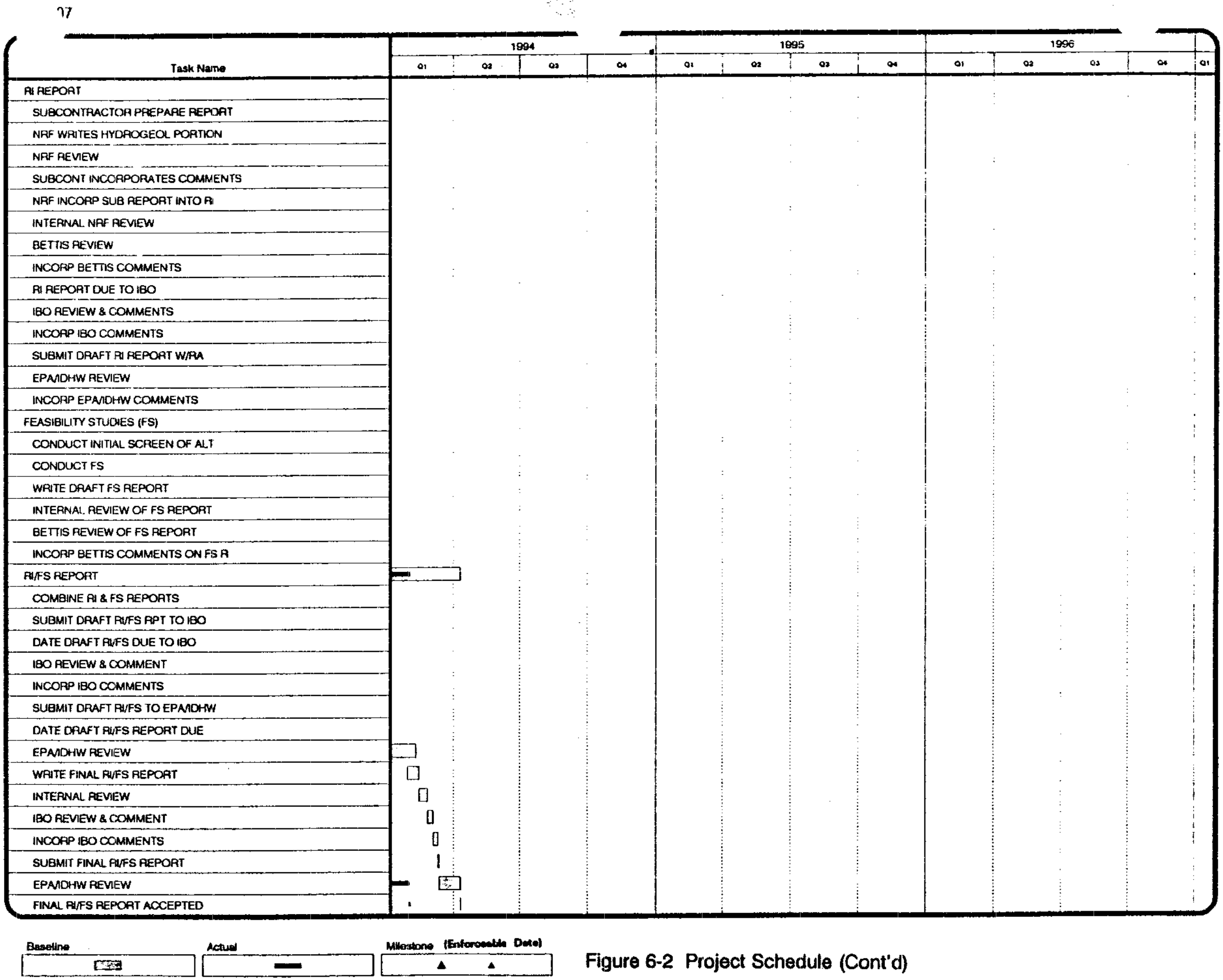
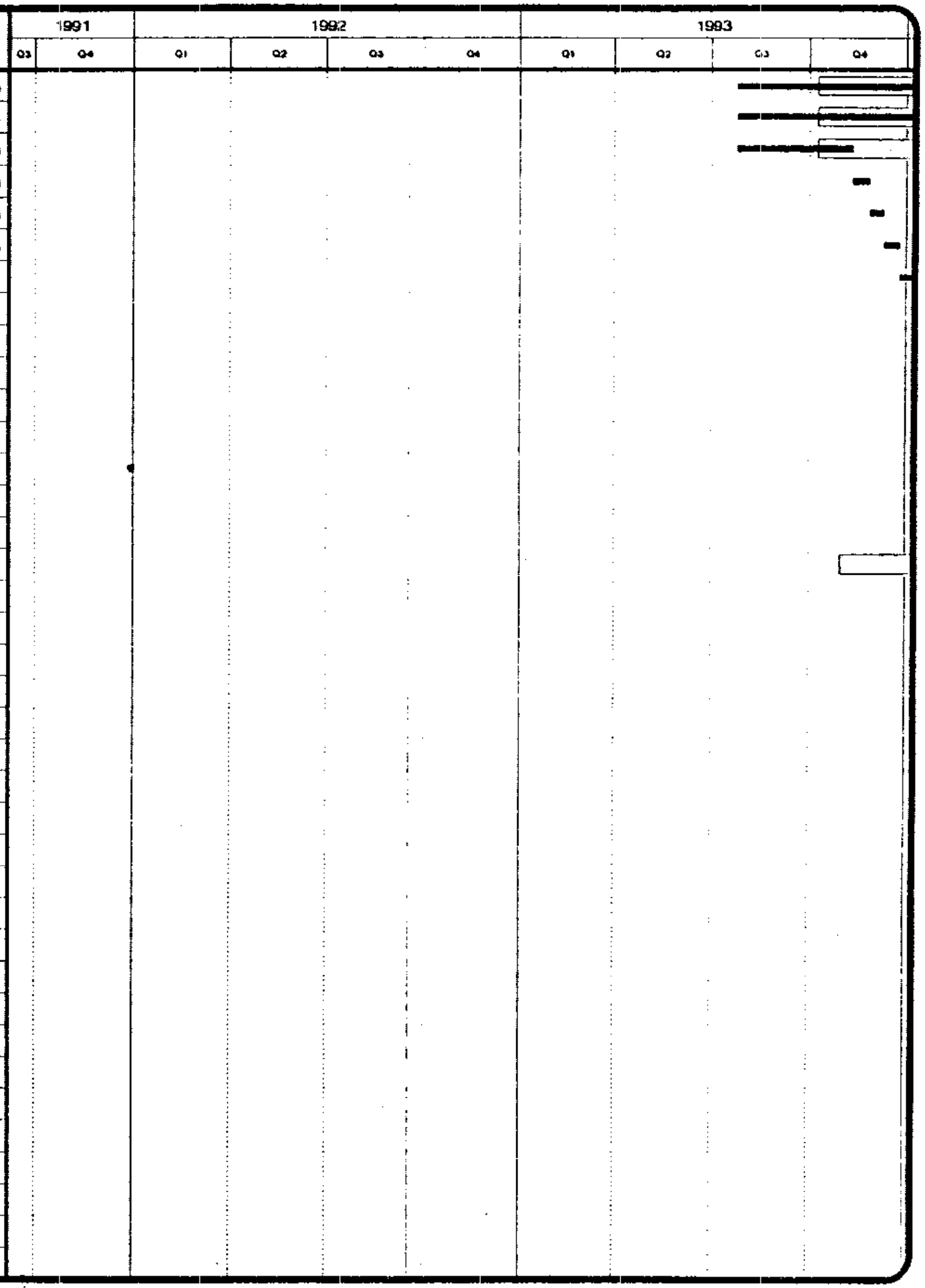


Figure 6-2 Project Schedule (Cont'd)

Task Name	Start Date	End Date
CERCLA DECISION PROCESS	25-Jul-93	31-Jan-95
PROPOSED PLAN (PP)	25-Jul-93	18-Apr-94
WRITE DRAFT PP	25-Jul-93	10-Nov-93
INTERNAL REVIEW OF PP	11-Nov-93	25-Nov-93
BETTIS REVIEW OF PP	26-Nov-93	9-Dec-93
INCORP BETTIS COMMENTS ON PP	10-Dec-93	24-Dec-93
IBO REVIEW & COMMENTS ON PP	25-Dec-93	23-Jan-94
FINAL PP DUE TO IBO	17-Mar-94	17-Mar-94
INCORP IBO COMMENTS TO PP	24-Jan-94	6-Feb-94
SUBMIT PP TO EPA/IDHW	7-Feb-94	7-Feb-94
EPA/IDHW REVIEW OF PP	8-Feb-94	11-Mar-94
REVISE PP	12-Mar-94	25-Mar-94
INTERNAL REVIEW OF PP	26-Mar-94	2-Apr-94
IBO REVIEW & COMMENT ON PP	3-Apr-94	10-Apr-94
INCORP IBO COMMENTS	11-Apr-94	18-Apr-94
DRAFT RECORD OF DECISION (ROD)	19-Apr-94	30-Oct-94
PUBLIC COMMENT PERIOD	19-Apr-94	19-May-94
ADDRESS PUBLIC CONCERNS	20-May-94	11-Jun-94
INTERNAL REVIEW	1-Jun-94	15-Jun-94
ISSUE DRAFT ROD TO IBO	16-Jun-94	16-Jun-94
DRAFT ROD DUE TO IBO	31-Aug-94	31-Aug-94
IBO REVIEW & COMMENT	17-Jun-94	16-Jul-94
INCORP IBO COMMENTS	17-Jul-94	16-Aug-94
SUBMIT DRAFT ROD TO EPA/IDHW	17-Aug-94	17-Aug-94
DRAFT ROD IS DUE TO EPA/IDHW	31-Oct-94	31-Oct-94
EPA/IDHW REVIEW	18-Aug-94	1-Oct-94
FINAL ROD (FR)	2-Oct-94	31-Jan-95
WRITE FR	2-Oct-94	25-Oct-94
INTERNAL REVIEW OF FR	26-Oct-94	29-Oct-94
ISSUE FR TO IBO	30-Oct-94	30-Oct-94
FR DUE TO IBO	13-Jan-95	13-Jan-95
IBO REVIEW & COMMENT OF FR	31-Oct-94	14-Nov-94
SUBMIT FR TO EPA/IDHW	15-Nov-94	15-Nov-94
FR DUE TO EPA/IDHW	31-Jan-95	31-Jan-95
EPA/IDHW REVIEW OF FR	18-Nov-94	16-Dec-94
FR ACCEPTED	17-Dec-94	17-Dec-94



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e 6.2 Project Schedule (Cont'd)

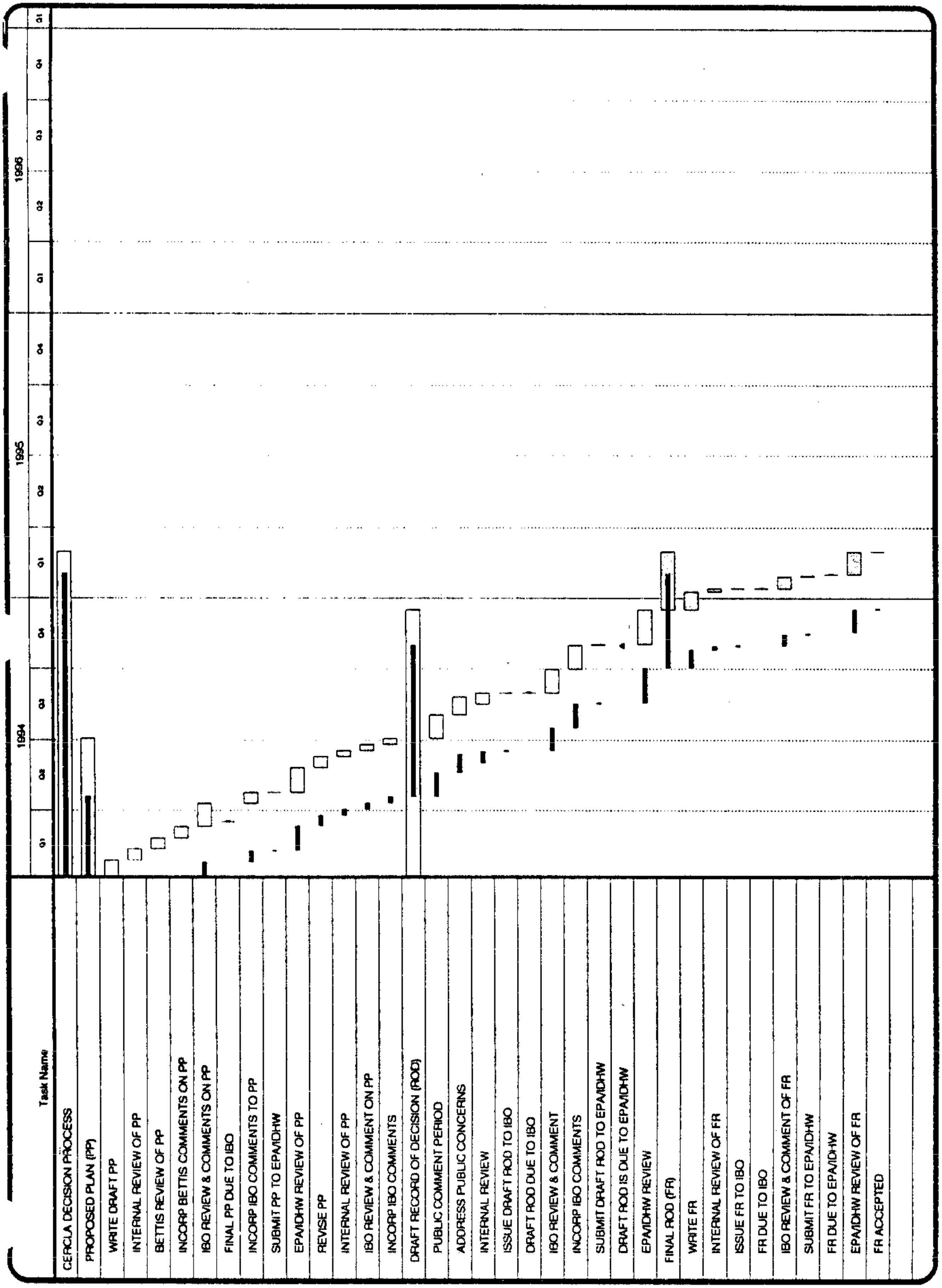

Figure 6.2 Project Schedule (Cont'd)

6.3.2 Feasibility Studies

After completion of the data evaluation portion of the RI, the FS work will begin. The time frame for this task overlaps the RI work, and is scheduled from December 1992 to October 1993. Tasks included in this work are:

- Conducting initial screening of alternatives
- Conducting the FS
- Writing the draft FS report
- NRF and Bettis review
- Review by IBO

6.3.3 RI/FS Report

This task combines the findings from the RI and FS. The scheduled time frame for this work is from October 1993 through April 1994. After preparation of the draft RI/FS Report, it will be reviewed by IBO, the EPA, and the IDHW. Comments from these reviews will be incorporated, and acceptance of the final report is scheduled in April 1994.

6.3.4 Proposed Plan

The Proposed Plan (PP) utilizes the findings from the RI/FS report, and proposes a scenario for the clean up of the exterior portion of the IWD. The preparation of the PP is scheduled to begin in October 1993, while the RI/FS report is still in preparation, and end in July 1994.

6.3.5 Record of Decision

The ROD is the final document prior to field clean-up actions. The PP is used as the basis for the ROD. During the preparation of the ROD, the public will be given one month to comment on the PP. Public concerns will be incorporated into the draft ROD. After review and incorporation of IBO and EPA/IDHW comments, EPA/IDHW will accept the final ROD; this is scheduled for March of 1995.

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